



Missouri Department of Natural Resources

Niangua River Biological Assessment Report

Dallas and Webster Counties, Missouri

Fall 2022 and Spring 2023

Prepared for:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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1.0 Introduction

The Niangua River is a highly valued Missouri stream with diverse habitat types and sustained base flows that support biological communities associated with the Ozark faunal region (Pflieger 1989), including protected species like the Niangua darter (*Etheostoma nianguae*) and the Ozark hellbender (*Cryptobranchus alleganiensis*). This habitat heterogeneity also supports various gamefish, making the river popular among anglers. Notably, the Niangua River becomes the Big Niangua Arm of Lake of the Ozarks, one of the most recreated water bodies in the state and the fifth largest tourist destination in Missouri (MDT 2023). In addition to the ecological, aesthetic, and recreational values of the Niangua River, it is also used for irrigation and wastewater and stormwater discharge (Schulz 2001).

Over time, the Niangua River adapts to reflect point source events, such as municipal wastewater plant failures and more prolonged, watershed-scale changes in land use (Schulz 2001). Ecological deterioration from such changes can be reflected in biota, particularly benthic macroinvertebrate communities (Barbour et al. 1999). Biological monitoring can provide valuable insights regarding water quality that can help preserve the integrity of the Niangua River and its ecosystem.

1.1 Purpose and Objectives

The Missouri Department of Natural Resources' (**MoDNR**) Water Protection Program directed the Environmental Services Program's (**ESP**) Water Quality Monitoring Section (**WQMS**) to conduct a biological assessment of macroinvertebrates and a habitat study of the Niangua River. Although portions of the Niangua River have been studied by the Missouri Department of Conservation (**MDC**), the upper and middle reaches of the river, including water body identification number (**WBID**) 1170, have not been recently examined by the State of Missouri for macroinvertebrates (Schulz 2001; Smale et al. 1995). Therefore, the objectives of this study were to 1) inventory the macroinvertebrate community, 2) examine water quality, nutrient parameters, and habitat quality, and 3) determine if each of these parameters attained criteria that support the warm water habitat beneficial use designation within this segment of the Niangua River.

2.0 Study Area

2.1 MoRAP Classification

The Missouri Resource Assessment Program (**MoRAP**) developed a hierarchal classification of the state's aquatic resources. The classification has seven levels that were determined by the hydrology, biology, and geology of specific geographic areas, among other factors (Sowa et al. 2007). The levels, from geographically largest to smallest, are as follows: zone, subzone, region, aquatic sub-region, ecological drainage unit (**EDU**), aquatic ecological system (**AES**), and valley segment type (**VST**).

The Niangua River is located in the Nearctic zoogeographic zone, in the Arctic/Atlantic drainage subzone, within the Mississippi River drainage region, in the Ozarks aquatic sub-region, in the Ozark/Osage EDU. The studied segment of the Niangua River (WBID 1170) encompasses the Tavern Creek and Jacks Fork AES types and six different VSTs, as stream size, geology, and gradient vary slightly along the segment. Although portions of the Niangua River are classified

as cold water, the entirety of WBID 1170 is a permanent, warm water stream. This stretch is used for whole body contact recreation (category A) and irrigation (MoDNR 2022h). The geology is predominantly dolomite/limestone and sandstone.

2.2 Land Cover

The Niangua River is a sixth order stream that flows 120 miles through a predominantly forested, 1,040 square mile watershed before it transitions to the Lake of the Ozarks (Schulz 2001; Table 1; Figure 1). The studied segment of the river, WBID 1170, has proportionally more pasture on the landscape than the rest of the watershed and the Ozark/Osage EDU (Table 1). Urban uses are relatively sparse, occurring in smaller towns such as Buffalo and Marshfield, and areas near Lake of the Ozarks (Figure 1). Land cover was determined using the National Land Cover Database (USGS 2021).

Table 1. Percent land uses in the Ozark/Osage EDU, Niangua River watershed, study watershed, and the Little Niangua River biological criteria reference watershed.

	EDU	Niangua River	Upstream of Site 7.4	Little Niangua
Urban	6.2	5.4	5.9	4.2
Open Water	3.0	1.1	0.2	1.0
Forest	49.0	59.3	46.5	61.0
Wetland	0.8	0.4	0.1	0.7
Barren Land	0.2	0.1	0.1	0.1
Scrub/Shrub	0.9	1.0	0.8	1.4
Herbaceous	0.5	0.5	0.3	0.5
Hay/Pasture	37.3	32.0	45.8	31.1
Cropland	2.1	0.2	0.3	0.0

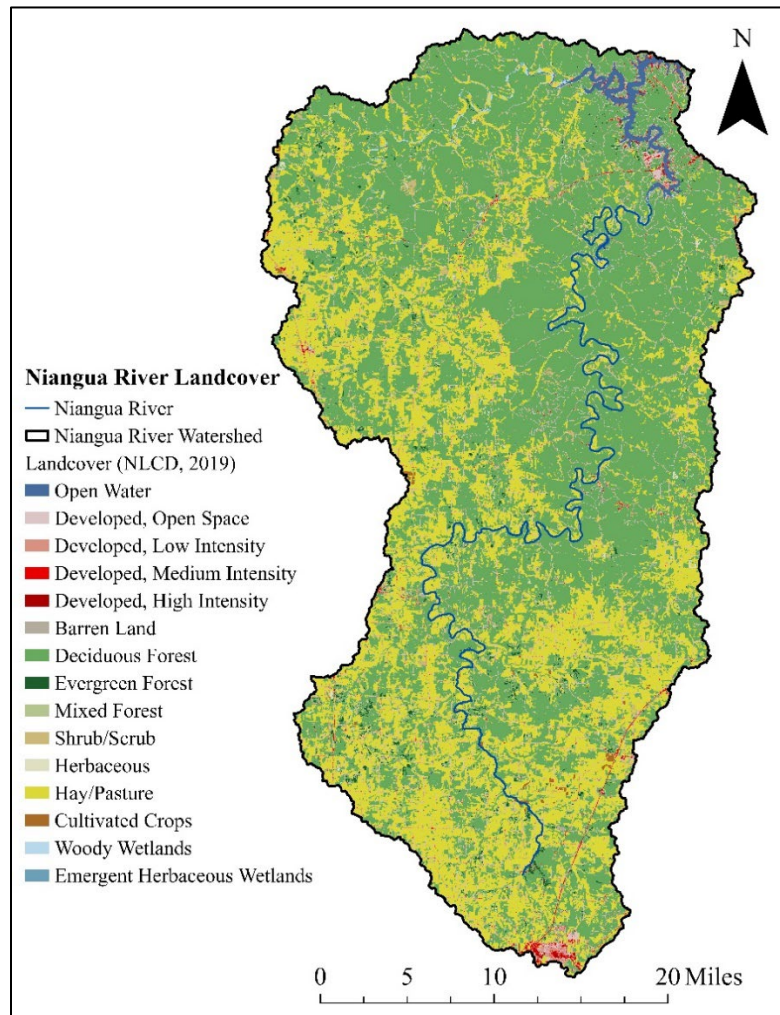


Figure 1. Land cover of the Niangua River watershed, as determined by the National Land Cover Database (USGS 2021).

3.0 Methods

3.1 Station Locations and Descriptions

Macroinvertebrate and water quality sampling were conducted at five stations in fall of 2022 and spring of 2023 by the WQMS's Aquatic Bioassessment Unit. Stations were chosen based on accessibility, flow condition, and their representation of the watershed. Most sampling stations were located within Dallas County and accessible via public lands maintained by the MDC. The sole exception was station 55.5, which was on private property located in Webster County (Figure 2). Zone 15 Universal Transverse Mercator (**UTM**) coordinates were collected at the downstream boundary of each sample reach (Table 2).

Table 2. Macroinvertebrate, water quality, and habitat sampling locations on the Niangua River (water body identification number 1170). Zone 15 UTM coordinates were collected at the downstream boundary of the sample reaches.

Site	County	Description	UTM	Decimal Degrees
55.5	Webster	Below Long State Highway Y	506689E, 4144905N	37.4506, -92.9244
48.4	Dallas	Below State Road M; MDC Charity Access	501486E, 4152844N	37.5210, -92.9830
28.7	Dallas	Below Steelman Road; MDC Big John Access	496105E, 4166079N	37.6420, -93.0443
17.7	Dallas	Below Benton Branch Road; MDC Williams Ford Access	503888E, 4171664N	37.6923, -92.9559
7.4	Dallas	Below Moon Valley Road; MDC Moon Valley Access	510431E, 4172835N	37.7028, -92.8821

3.2 Macroinvertebrate Sampling and Analysis

Macroinvertebrate sampling was conducted using methods described in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (MoDNR 2019a). The Niangua River was considered a riffle/pool dominated system; therefore, coarse substrate with flowing water, non-flowing water over depositional substrate, and submerged rootmat habitats were sampled at five stations in September 2022 and April 2023. Macroinvertebrate samples were preserved in 10 percent buffered formalin and transported to the ESP Biology Laboratory for processing (MoDNR 2019a). Collected material was subsampled, and organisms were identified to the taxonomic levels specified in the MoDNR's *Taxonomic Levels for Macroinvertebrate Identifications* standard operating procedure (SOP), which was usually genus or species (MoDNR 2022e).

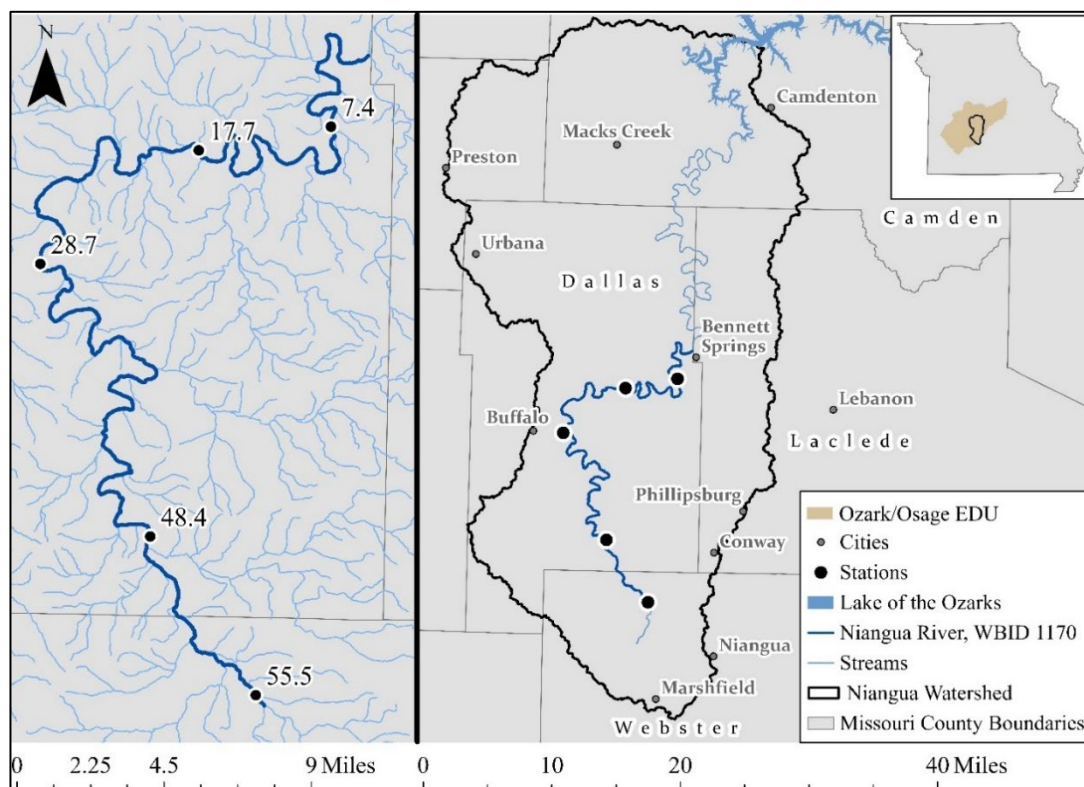


Figure 2. Locations of macroinvertebrate, water quality, and habitat sampling stations on the Niangua River.

Macroinvertebrate communities in the Niangua River were evaluated using biological criteria for riffle/pool dominated streams in the Ozark/Osage EDU (Appendix B). Biological criteria were calculated separately for the fall (mid-September through mid-October) and spring (mid-March through mid-April) index periods. Four metrics — taxa richness (**TR**), Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**), biotic index (**BI**), and Shannon Diversity Index (**SDI**) — were calculated for each station and incorporated into a Macroinvertebrate Stream Condition Index (**MSCI**) score. MSCI scores of 16-20 qualified as fully supporting, 10-14 were partially supporting, and 4-8 were considered non-supporting of the protection of warm water habitat beneficial use designation as specified in the Missouri Water Quality Standards (**WQS**; MoDNR 2022h, 2019a).

3.3 Physiochemical Water Sampling and Analysis

Surface water grab samples and *in situ* water quality measurements were collected at each station during both sampling periods. Grab samples were collected per SOP MDNR-ESP-001, *Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2022a). The ESP's Chemical Analysis Section analyzed water samples for the following: calcium, magnesium, ammonia as nitrogen, chloride, nitrate plus nitrite as nitrogen (**NO₃+NO₂ as N**), sulfate, total nitrogen (**TN**), total phosphorus (**TP**), total recoverable hardness as calcium carbonate, and total suspended solids. Dissolved oxygen, turbidity, pH,

water temperature, and specific conductance were measured *in situ* with a YSI ProDSS multiparameter meter (MoDNR 2019b, 2021, 2022b, 2022c, 2022d). Flow was determined using a SonTek FlowTracker 2 in accordance with SOP MDNR-ESP-113, *Flow Measurements in Open Channels* (MoDNR 2020). Physicochemical water parameters were compared among stations as well as with Missouri's WQS (MoDNR 2022h). Nutrient values were compared to the United States Environmental Protection Agency (USEPA) recommended nutrient criteria for rivers and streams in ecoregion 39, the Ozark Highlands (USEPA 2000).

3.4 Stream Habitat Assessment Project Procedure

Aquatic macroinvertebrate communities are influenced by the quality of stream habitat, with heterogeneous habitats tending to facilitate diversity (Barbour and Stribling 1991). Therefore, Stream Habitat Assessment Project Procedures (SHAPP, MoDNR 2019c) were conducted at all five stations and compared to a control site within the Ozark/Osage EDU. For this study, the Little Niangua River at Mule Shoe Conservation Area was chosen as a control. Stations with scores that were ≥ 75 percent of the control score were considered to have comparable habitat and, by extension, the ability to support similar biological communities.

3.5 Quality Assurance/Quality Control (QA/QC)

Quality assurance and quality control measures were implemented throughout the study, including field and laboratory procedures. Multiparameter meters used for *in situ* water quality measurements were regularly calibrated and maintained according to MoDNR protocols (MoDNR 2022f). Subsampling efforts were periodically checked for missed organisms (MoDNR 2019c) and all biological data entered into the WQMS's macroinvertebrate database were reviewed (MoDNR 2022g). Additionally, duplicate samples of physiochemical parameters were collected in spring and fall from station 55.5. Duplicate samples were used to assess consistency with sampling methodology, sample heterogeneity, and analytical procedures (MoDNR 2023).

4.0 Results

4.1 Biological Assessment and Macroinvertebrate Community Analysis

During this study of the Niangua River, 208 taxa were collected ($n = 10$ samples), including 71 EPTT (for full taxa lists, see Appendix A). *Elimia* snails and *Caenis latipennis* mayflies were the most abundant taxa, making up 18.2 percent and 9.7 percent of total macroinvertebrate density, respectively. Although the most abundant macroinvertebrates collected in this study were common and tolerant of pollution, more sensitive taxa ($BI < 2.5$) were also present. Among these sensitive taxa were nine mayfly genera, nine stonefly genera, and six caddisfly genera. Additionally, *Lopescladius*, a chironomid midge, and *Roederiodes*, an empidid fly, were found in the Niangua River, which are rarely encountered in samples collected by the WQMS.

Fall 2022

In the fall samples ($n = 5$), 138 taxa were collected. Mayflies accounted for over 25 percent of macroinvertebrates at each site. The mayfly genera *Tricorythodes* and *Caenis* were most abundant and were collected at all five stations. *Elimia* snails were also among the most dominant taxa at the two farthest downstream stations, 17.7 and 7.4, making up nearly one third of the samples there (Table 3).

Table 3. Fall 2022 relative abundances (percent) of common taxa in Niangua River.

	Reference Samples	55.5	48.4	28.7	17.7	7.4
% EPTT	42.32	48.29	57.99	51.57	35.71	39.13
% Ephemeroptera	34.77	42.73	44.16	49.63	32.37	28.14
% Plecoptera	0.74	0.15	0.00	1.12	1.82	3.25
% Trichoptera	6.81	5.41	13.83	0.82	1.52	7.74
Percent Dominant Families						
Baetidae	2.31	0.99	9.19	4.25	3.27	3.25
Caenidae	11.27	32.75	18.38	6.04	5.62	2.50
Chironomidae	21.06	15.23	13.06	9.18	8.81	16.40
Coenagrionidae	4.12	5.33	0.86	4.55	4.48	1.58
Elmidae	7.86	4.11	2.49	5.37	6.38	3.33
Helicopsychidae	0.35	0.00	2.58	0.22	0.61	4.75
Heptageniidae	9.87	3.50	4.30	18.96	10.64	9.16
Hyaellidae	6.54	15.00	5.24	8.51	0.00	2.41
Hydropsychidae	3.67	4.57	8.93	0.30	0.23	0.75
Leptohyphidae	7.22	4.11	5.84	10.07	7.60	9.08
Pleuroceridae	2.41	2.59	12.63	10.75	30.24	30.89
Percent Dominant Taxa						
<i>Baetis</i>	1.15	0.23	8.51	2.46	2.05	2.50
<i>Caenis anceps</i>	3.04	0.76	8.08	5.52	3.80	2.50
<i>Caenis latipennis</i>	7.28	31.99	10.31	0.52	1.82	0.00
<i>Cheumatopsyche</i>	3.67	4.57	5.41	0.30	0.15	0.75
<i>Dubiraphia</i>	3.61	0.61	0.95	1.04	3.65	1.08
<i>Elimia</i>	2.12	2.59	12.63	10.75	30.24	30.89
<i>Enallagma</i>	2.46	3.58	0.52	2.91	3.57	0.75
<i>Helicopsyche</i>	0.35	0.08	2.58	0.22	0.61	4.75
<i>Hyaella azteca</i>	5.18	15.00	5.24	8.51	0.00	2.41
<i>Leucrocuta</i>	0.30	0.00	0.34	1.79	1.75	4.58
<i>Polypedilum flavum</i>	2.94	3.50	1.46	1.34	0.84	3.75
<i>Psephenus herricki</i>	0.94	3.66	1.03	2.31	1.29	1.50
<i>Stenacron</i>	1.35	0.30	0.17	10.45	1.06	2.58
<i>Tanytarsus</i>	4.18	1.75	0.95	0.60	2.28	2.16
<i>Tricorythodes</i>	7.37	4.11	5.84	10.07	7.60	9.08

Values in bold typeface indicate the 5 highest abundances for each sample.

Analysis of functional feeding groups (FFG) can provide further insights into the macroinvertebrate community health, habitat availability, riparian condition, nutrient loading, and food web interactions (Cummins 2018). To further assess community health in the Niangua River, proportions of FFGs at each station were calculated and are shown in Figure 3. In the fall,

the Niangua River macroinvertebrate community was primarily composed of gatherer collectors, such as *Tricorythodes* and *Caenis*, and scrapers, such as *Elimia*. Scrapers were most prominent at stations 7.4 and 17.7, where *Elimia* was dominant, but gatherer collectors were dominant farther upstream. Abundance of predators and filterer collectors remained consistent across stations in the fall.

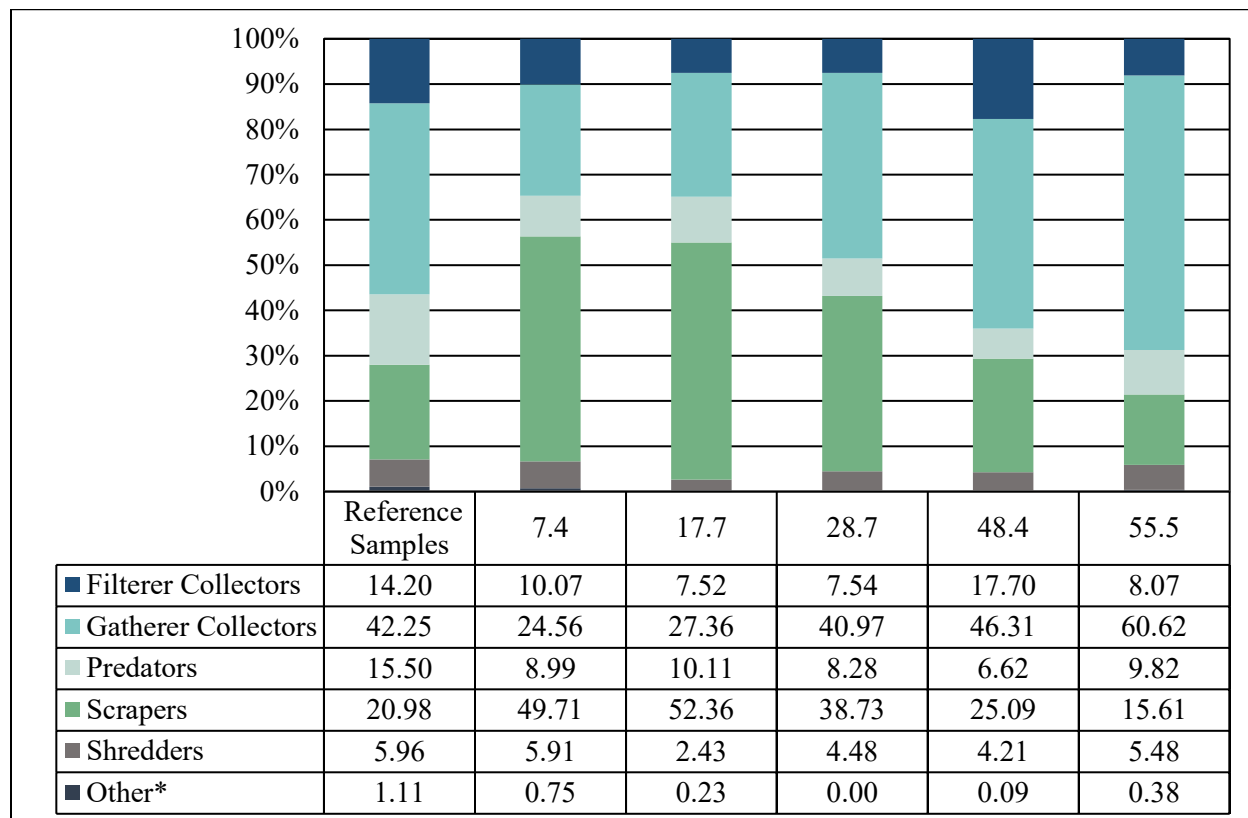


Figure 3. Percent of taxa by functional feeding group in the Niangua River for the fall 2022 sampling period. *"Other" includes parasites, macrophyte piercers, and taxa with no identified FFG.

The BI is a surrogate measure of organic pollution, with lower BI values indicating an intolerance to organic pollution and higher values indicating increased tolerance (MoDNR 2019a). Four of the five fall samples from the Niangua River had more intolerant macroinvertebrate taxa ($BI < 2.5$) than the reference samples (Figure 4). The sole exception was the farthest upstream station, 55.5, which was dominated by *Caenis latipennis* ($BI = 7.6$) and *Hyaella azteca* ($BI = 7.9$). The Niangua River also had low abundances of highly tolerant taxa ($BI \geq 9$) relative to the reference samples.

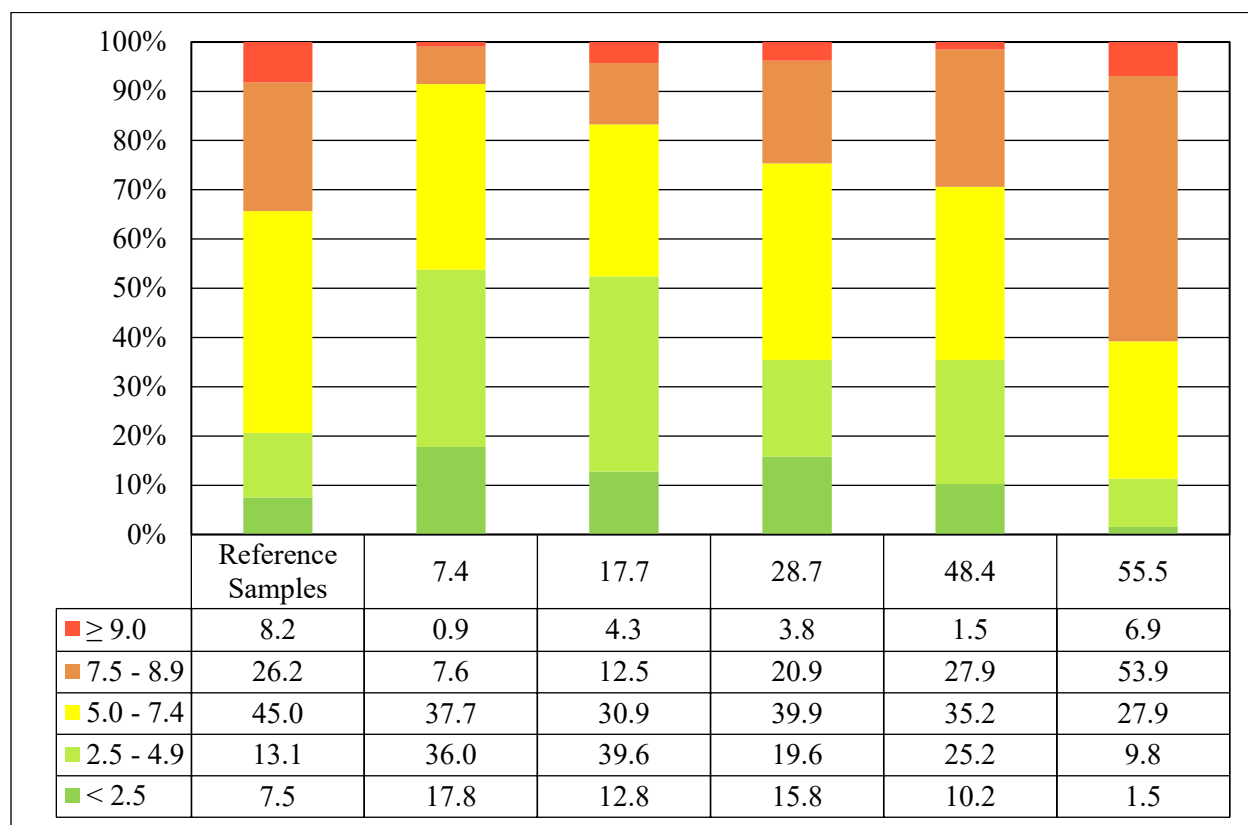


Figure 4. Percent sensitive taxa by biotic index in the Niangua River for the fall 2022 sampling period.

Spring 2023

Taxa richness was higher in the spring than the fall, with 176 taxa collected ($n = 5$). Diptera accounted for over 30 percent of macroinvertebrates at all sites except 48.4 (23 percent; Table 4). Chironomids accounted for the most dipteran taxa, with *Cricotopus/Orthocladius* and *Eukiefferiella* being the most abundant. Mayflies were also abundant, making up 18 - 40 percent of each sample, though all stations had fewer mayflies than in the fall. Stoneflies, however, were more prevalent in the spring. Like the fall samples, *Elimia* snails were also common, making up over 20 percent of samples at sites 48.4, 28.7, and 7.4 (Table 4).

Table 4. Spring 2023 relative abundances (percent) of common taxa in Niangua River.

	Reference Samples	55.5	48.4	28.7	17.7	7.4
% EPTT	29.20	51.57	27.61	29.00	41.20	30.43
% Ephemeroptera	19.41	39.87	18.17	23.03	29.30	23.87
% Plecoptera	7.18	10.99	3.59	3.45	9.20	4.19
% Trichoptera	2.61	0.71	5.85	2.52	2.70	2.37
Percent Dominant Families						
Baetidae	3.03	8.01	4.21	1.85	4.70	1.29
Caenidae	7.57	21.90	9.96	3.70	5.20	5.70
Chironomidae	47.26	31.24	20.33	30.59	29.40	31.61
Elmidae	3.29	5.65	4.93	3.78	2.20	5.05
Glossosomatidae	0.03	0.00	4.62	0.25	0.40	0.00
Heptageniidae	4.41	9.11	2.98	7.65	8.50	7.85
Hyalellidae	4.26	0.08	0.51	0.59	0.20	1.72
Perlidae	3.34	5.73	3.08	2.35	7.50	3.98
Pleuroceridae	0.76	1.02	37.78	20.92	12.50	22.37
Potamanthidae	0.08	0.00	0.00	1.43	1.50	5.48
Percent Dominant Taxa						
<i>Anthopotamus</i>	0.04	0.00	0.00	1.43	1.50	5.48
<i>Caenis latipennis</i>	5.11	19.07	9.96	3.70	5.10	5.16
<i>Cladotanytarsus</i>	1.38	0.00	2.67	7.14	7.10	1.94
<i>Cricotopus/Orthocladius</i>	14.45	7.22	5.24	6.30	3.20	4.41
<i>Elimia</i>	0.69	1.02	37.78	20.92	12.50	22.37
<i>Eukiefferiella</i>	6.26	13.03	4.72	0.84	1.70	1.18
<i>Hyaella azteca</i>	2.88	0.08	0.51	0.59	0.20	1.72
<i>Leucrocota</i>	0.23	6.59	0.82	0.67	0.30	1.61
<i>Perlesta</i>	1.72	5.73	2.87	0.84	5.30	1.18
<i>Rhithrogena</i>	0.05	0.00	0.00	3.19	4.80	3.66
<i>Simulium</i>	2.70	0.55	0.21	3.36	3.30	1.51
<i>Stenelmis</i>	2.80	5.26	4.72	3.28	1.80	4.62
<i>Tanytarsus</i>	4.22	0.47	0.41	2.61	3.90	6.34

Values in bold typeface indicate the 5 highest abundances for each sample.

Gatherer collectors and scrapers were the most common FFGs in the spring. Unlike the fall samples, these FFGs did not show longitudinal patterns from upstream to downstream. However, gatherer collectors were most abundant farthest upstream and accounted for over half of the macroinvertebrates collected there. *Caenis latipennis* and many species of *Eukiefferiella* and *Cricotopus/Orthocladius* are designated as gatherer collectors, and these taxa were abundant at station 55.5. Filterer collectors did demonstrate a longitudinal pattern, with higher abundances downstream and fewer upstream (Figure 5).

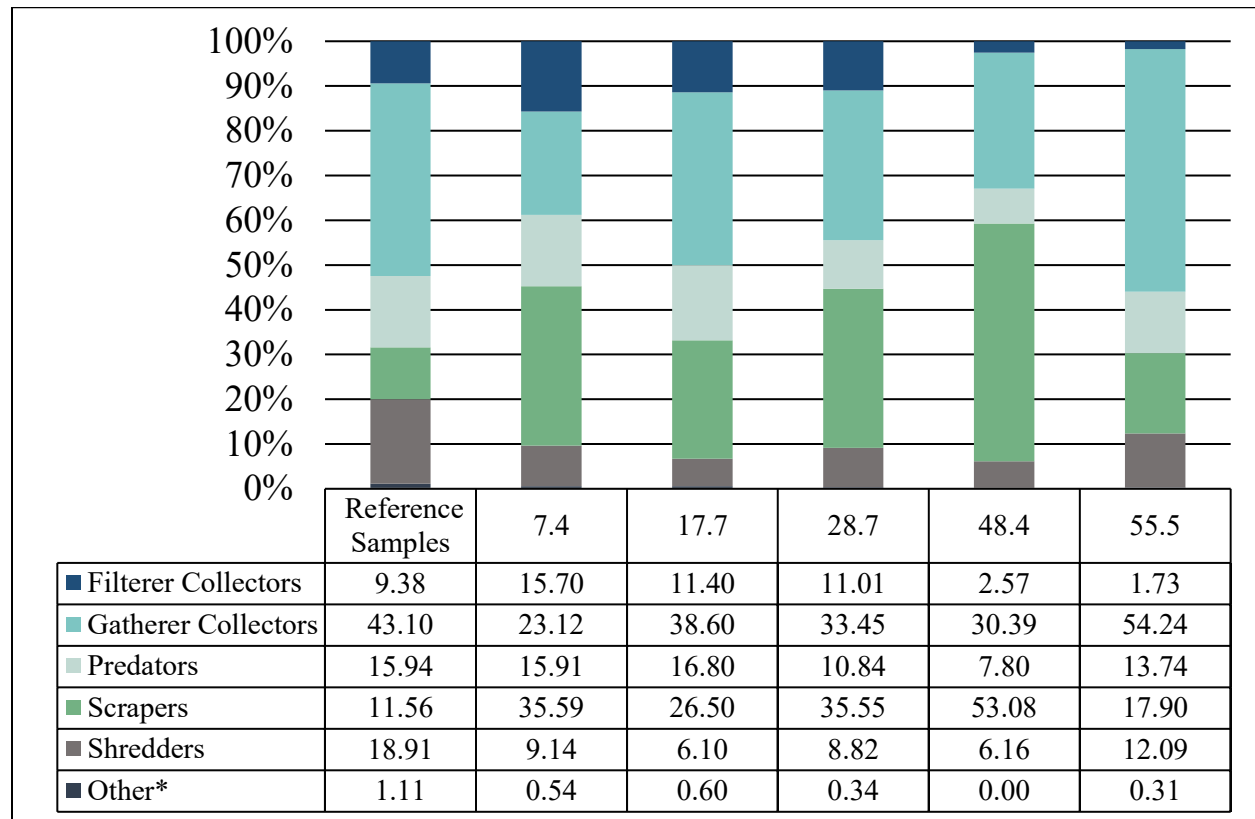


Figure 5. Percent of taxa by functional feeding group in the Niangua River for the spring 2023 sampling period. *"Other" includes parasites, macrophyte piercers, and taxa with no identified FFG.

Average BI scores were lower in the spring ($\bar{x}=4.4$) than the fall ($\bar{x}=5.2$; Table 5, Figure 6). All five spring samples had more very intolerant taxa ($BI < 2.5$) than the reference samples. Stoneflies are generally intolerant of organic pollution and were more abundant in the spring than in the fall, which contributed to lower BI scores. Stoneflies, particularly *Perlesta* ($BI = 0$), were collected at each station and were among the most dominant taxa at stations 55.5 and 17.7. These two stations also had the most intolerant ($BI < 2.5$) macroinvertebrates. Highly tolerant taxa ($BI \geq 9$) were uncommon among all spring samples.

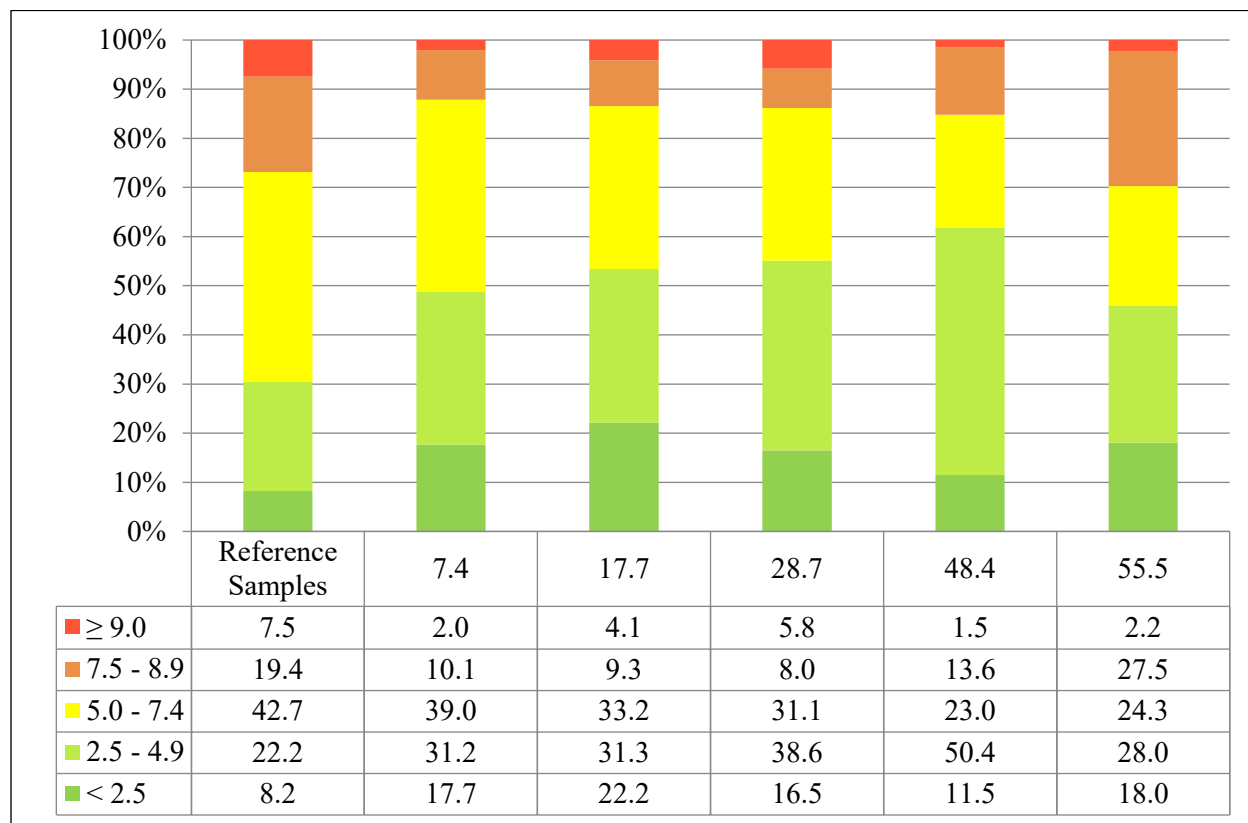


Figure 6. Percent sensitive taxa by biotic index in the Niangua River for the spring 2023 sampling period.

Summary

Generally, sampling stations in WBID 1170 of the Niangua River had diverse macroinvertebrate communities that supported use attainment goals. The most upstream station, 55.5, had the only MSCI score that was partially supporting the beneficial use designation for the protection of warm water habitat. Compared to other stations, the fall sample at station 55.5 had a higher abundance of tolerant taxa, the lowest taxa richness, and the fewest EPTT, which contributed to a partially supporting MSCI score of 14 (Table 5). However, station 55.5 had high relative abundance of EPTT because both fall and spring samples were dominated by *Caenis latipennis* mayflies (Table 3, 4). Among all samples for both seasons, TR ranged from 74 – 108 and EPTT ranged from 22 – 41, with the highest diversity occurring at station 28.7 in the spring (TR = 108, EPTT = 41; Table 5).

Table 5. Metrics and MSCI scores for the Niangua River using Ozark/Osage EDU biological criteria.

Site	TR	EPTT	BI	SDI	MSCI	Support
Fall 2022 Bioassessment						
55.5	74 ₍₃₎	22 ₍₅₎	6.7 ₍₃₎	2.85 ₍₃₎	14	Partial
48.4	82 ₍₃₎	27 ₍₅₎	5.3 ₍₅₎	3.35 ₍₅₎	18	Full
28.7	74 ₍₃₎	26 ₍₅₎	5.3 ₍₅₎	3.40 ₍₅₎	18	Full
17.7	80 ₍₃₎	31 ₍₅₎	4.5 ₍₅₎	3.19 ₍₃₎	16	Full
7.4	76 ₍₃₎	23 ₍₅₎	4.0 ₍₅₎	3.04 ₍₃₎	16	Full
Full Support	> 84	> 18	< 6.6	> 3.23	20 - 16	
Partial Support	84 - 42	18 - 9	6.6 - 8.3	3.23 - 1.61	14 - 10	
Non Support	< 42	< 9	> 8.3	< 1.61	8 - 4	
Spring 2023 Bioassessment						
55.5	89 ₍₃₎	28 ₍₅₎	4.9 ₍₅₎	3.20 ₍₅₎	18	Full
48.4	78 ₍₃₎	24 ₍₅₎	4.1 ₍₅₎	2.73 ₍₃₎	16	Full
28.7	108 ₍₅₎	41 ₍₅₎	4.4 ₍₅₎	3.62 ₍₅₎	20	Full
17.7	96 ₍₅₎	32 ₍₅₎	4.3 ₍₅₎	3.73 ₍₅₎	20	Full
7.4	87 ₍₃₎	33 ₍₅₎	4.4 ₍₅₎	3.40 ₍₅₎	18	Full
Full Support	> 89	> 21	< 6.2	> 3.16	20 - 16	
Partial Support	89 - 45	21 - 11	6.2 - 8.1	3.16 - 1.58	14 - 10	
Non Support	< 45	< 11	> 8.1	< 1.58	8 - 4	

Numbers in parentheses are scores for each biological metric.

4.2 Water Quality

Water quality met Missouri's WQS, but some nutrients exceeded the USEPA's recommended values for ecoregion 39 (Table 6, 7). In both fall and spring, TP exceeded the USEPA's recommendation of 0.007 mg/L at all stations. Similarly, TN was higher than the recommendation of 0.379 mg/L at all stations in spring and the two most upstream stations in fall. Lastly, NO₃+NO₂ as N exceeded the criterion of 0.239 mg/L at all locations except the two most downstream stations in the fall.

Some physicochemical parameters demonstrated spatial patterns, whereas others were more erratic. In both seasons, dissolved oxygen generally decreased from upstream to downstream, though Missouri's WQS of 5 mg/L was achieved at all stations. Likewise, conductivity, chloride, TN, and NO₃+NO₂ as N were lowest at the most downstream stations. Compared to nitrogen analytes, TP levels were more irregular, with the highest levels at station 28.7 in the fall and stations 55.5 (duplicate samples) and 7.4 in the spring. Hardness also varied among stations, though all stations are considered hard or very hard (USGS 2018).

Table 6. Fall 2022 Niangua River physicochemical parameters. The criteria column indicates recommended values from the Missouri WQS or USEPA.

Site	Criteria	55.5	55.5 (Duplicate)	48.4	28.7	17.7	7.4
Date		9/21/2022	9/21/2022	9/21/2022	9/20/2022	9/20/2022	9/20/2022
Time		11:25	11:25	8:40	14:23	11:50	9:25
Discharge (cfs)		0.18	0.14	16.90	30.10	29.96	26.68
Temperature (°C)		26.5	26.5	18.8	26.0	25.0	24.0
Dissolved Oxygen (mg/L)	5.0	10.75	10.74	6.51	8.69	6.92	7.17
Conductivity (µs/cm)		450.2	450.1	418.9	399.2	396	380.6
pH		7.42	7.41	7.38	7.75	7.68	7.72
Turbidity (FNU)	*	1.60	1.63	3.68	0.3 ND	5.12	2.61
Ca (mg/L)		45.8	28 ^{QC}	47.8	42.6	41.4	39.5
Mg (mg/L)		27	26.6	27.1	27.2	27.1	26.4
Ammonia as N (mg/L)	**	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND
Chloride (mg/L)		23.8	23.5	9.53	8.46	8.62	8.7
Nitrate + Nitrite as N (mg/L)	0.239	0.525	0.528	0.917	0.107	0.053	0.027
Sulfate (mg/L)		12.1	11.8	9.11	7.87	8.04	7.14 ^{MI}
TN (mg/L)	0.379	0.73	0.72	1.03	0.24	0.19	0.13
TP (mg/L)	0.007	0.049	0.047	0.047	0.07	0.04	0.037
TR Hardness as CaCO ₃ (mg/L)		226	180	231	218	215	207
TSS (mg/L)		< 5 ND	< 5 ND	< 5 ND	8	6	< 5 ND

ND = not detected at reported value

QC = estimated value, QC data outside limits

MI = Estimated value, matrix interference

*Criteria are 2.3 NTU and 1.7 FTU, but none for FNU exist

**Criteria are dependent on temperature and pH; all criteria in the Niangua River are > 0.02 mg/L.

Values in bold typeface exceeded USEPA recommended nutrient criteria.

Table 7. Spring 2023 Niangua River physicochemical parameters. The criteria column indicates recommended values from the Missouri WQS or USEPA.

Site	Criteria	55.5	55.5 (Duplicate)	48.4	28.7	17.7	7.4
Date		4/10/2023	4/10/2023	4/10/2023	4/10/2023	4/11/2023	4/11/2023
Time		9:15	9:15	10:55	13:05	11:10	9:05
Discharge (cfs)		52.78	54.98	127.80	227.02	266.47	244.82
Temperature (°C)		11.7	11.7	13.6	15.3	15.5	14.6
Dissolved Oxygen (mg/L)	5.0	10.72	10.72	10.80	10.52	9.76	9.67
Conductivity (µs/cm)		343.9	343.9	315.2	315.2	326	320.4
pH		7.67	7.66	7.6	7.92	7.97	7.69
Turbidity (FNU)	*	1.29	1.28	3.33	4.94	4.61	4
Ca (mg/L)		36.9	36.8	34.0	35.0	35.6	34.8
Mg (mg/L)		21.6	21.6	19.7	20.4	20.9	20.5
Ammonia as N (mg/L)	**	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND	< 0.02 ND
Chloride (mg/L)		9.59	9.89	8.42	7.36	7.23	7.24
Nitrate + Nitrite as N (mg/L)	0.093	0.976	0.968	1.099	0.806	0.638	0.544
Sulfate (mg/L)		6.62	6.88	6.52	6.62	7.61	6.63
TN (mg/L)	0.379	1.01	1.02	1.13	0.88	0.7	0.64
TP (mg/L)	0.007	0.05	1.34	0.049	0.036	0.032	0.086
TR Hardness as CaCO ₃ (mg/L)		181	181	166	171	175	171
TSS (mg/L)		< 5 ND	< 5 ND	5	6	8	7

ND = not detected at reported value

*Criteria are 2.3 NTU and 1.7 FTU, but none for FNU exist

**Criteria are dependent on temperature and pH; all criteria in the Niangua River are > 0.02 mg/L.

Values in bold typeface exceeded USEPA recommended nutrient criteria.

4.3 Stream Habitat Assessment

Habitat assessment scores of the Niangua River were comparable to that of the control stream, the Little Niangua River. All five stations scored higher than the control stream (Table 8). The average habitat score on the Niangua River was 142, which is 115 percent of the control score. Station 28.7 at the MDC's Big John Access scored the lowest, mainly due to higher occurrences of sediment deposition, lower bank stability, and lower quality of riffle habitat. Conversely, station 48.4 at the MDC's Charity Access scored highest and had high riffle quality, intact riparian zones, and heterogeneous velocities and depths.

Table 8. Habitat scores of the Niangua River by station compared to control conditions on the Little Niangua River

Stream Habitat Parameters	55.5	48.4	28.7	17.7	7.4	Little Niangua 1189/26.3
Habitat Assessment Date	10/11/22	10/11/22	10/11/22	10/11/22	10/11/22	10/12/22
Epifaunal Substrate/Cover	19	18	16	18	17	14
Embeddedness	18	19	17	19	16	19
Velocity/Depth Regime	16	20	15	16	19	19
Sediment Deposition	11	11	6	11	10	5
Channel Flow Status	15	14	15	15	15	11
Channel Alteration	19	20	19	19	20	20
Riffle Quality	15	15	11	12	15	12
Left Bank Stability	7	3	3	6	8	3
Right Bank Stability	7	7	3	3	5	5
Left Bank Vegetative Protection	2	2	2	2	3	1
Right Bank Vegetative Protection	2	5	2	2	4	3
Left Bank Riparian Zone Width	7	10	9	8	9	3
Right Bank Riparian Zone Width	10	10	10	4	3	9
Total Habitat Score	148	154	128	135	144	124
Percent of Control	119	124	103	109	116	

4.4 Quality Assurance/Quality Control

Duplicate samples of physicochemical parameters at station 55.5 were within acceptable ranges of variation for all parameters except TP in the spring (0.05 mg/L and 1.34 mg/L, Table 7). The relative percent difference was 185.6 percent. This exceptionally large difference was due to an unusually high TP concentration in the duplicate sample. The cause of this high TP concentration and resulting relative percent difference between samples is unknown.

5.0 Discussion

5.1 Biological Communities

The Niangua River study reach generally had a macroinvertebrate community that was comparable to reference communities in the Ozark/Osage EDU. The fall sample at station 55.5 had lower TR, BI, and SDI scores than reference samples and the only partially supporting MSCI score, which was likely due to low flow conditions. Drought reduces instream habitat heterogeneity and, consequently, lowers TR and increases dominance (Stubbington et al. 2009). Low flow conditions may have affected macroinvertebrate communities elsewhere in the fall, as none of the samples attained full support for TR (> 84). In spring, though, flow conditions were normal, most metrics were comparable to reference criteria, and all MSCI scores indicated full support.

Caenidae and *Elimia* were among the most abundant taxa collected in this study, and their populations demonstrated some patterns. In both seasons, the highest abundances of Caenidae were found upstream, at stations 55.5 and 48.4. The most common mayfly in this family was *Caenis latipennis*, which prefers stagnant water and silty substrates (Provonsha 1990). Sediment deposition scores in the SHAPP were among the highest at these two locations, suggesting sufficient availability of fine substrates to support strong populations of these mayflies. *Elimia* were among the most dominant taxa at all stations except 55.5 (Table 3, 4). In the fall, these snails gradually increased in abundance downstream, but this pattern was absent in spring. *Elimia* can be limited by competition for periphyton, their food source (Huryn et al. 1995), which may be influencing their populations in the Niangua River.

Fall bioassessment data demonstrated an increase of scrapers and a reduction in gatherer collectors as the stations progress downstream, which may indicate that upstream habitats are more disturbed. Macroinvertebrate FFGs respond to anthropogenic effects on aquatic ecosystems, with stressed communities having fewer specialists (e.g. scrapers) and more generalists (e.g. gatherer collectors). As environments become more stressed, specific food sources can become limited and specialized organisms can disappear, whereas generalist FFGs can be more adaptable and use a wider array of food sources (Barbour et al. 1999). Although these trends were not replicated in spring, the farthest upstream station, 55.5, continued to have more gatherer collectors than the other stations, which could be a response to pollution or nutrient enrichment.

The four MDC river accesses sampled in this study were also examined for macroinvertebrates from 1991-1994 by Smale et al. (1995). Although methods varied slightly between these two studies, there were differences in the macroinvertebrate communities over time. Spring and fall multihabitat macroinvertebrate samples contained 29 genera that were not found in the present study, including 8 EPTT. A winter stonefly, *Taeniopteryx*, was abundant and present at all stations but was absent in 2022-2023. *Taeniopteryx* nymphs are typically present in streams from late fall into winter (Heth and Heth 2018) but were uncommon in samples collected by the WQMS due to the timing of sampling. Smale et al. (1995) usually sampled in May and October, but early spring or late fall samples could have captured more of these stoneflies. Despite differences in community structures, trends in average TR and SDI scores remained similar between the two time periods, except for the downstream-most station. Taxonomic resolutions

differed between the studies (e.g. Smale et al. [1995] did not identify Chironomidae past family), so only trends are discussed. Of the stations sampled in both studies ($n = 4$), station 48.4 had the lowest TR and SDI scores. The middle stations, 28.7 and 17.7, had similar TR and SDI scores. Station 7.4, though, had the highest average TR and SDI score in the Smale et al. (1995) study, but the second lowest in the present study (mean TR = 81, SDI = 3.22). This discrepancy was largely due to dominance. Chironomidae and Gastropoda (snails) accounted for about half of the community for each season (47 percent fall, 54 percent spring) in our study, whereas these taxa made up only 35 percent of the past community. Nutrient loading reduces instream faunal diversity (Bini et al. 2014) and may be contributing to increased dominance of tolerant taxa at site 7.4 and elsewhere in the Niangua River.

5.2 Water Quality

Water quality in the Niangua River was typical of Ozark streams (Smale et al. 1995, Schulz 2001) and was in compliance with MoDNR WQS (MoDNR 2022h). However, TP, TN, and $\text{NO}_3 + \text{NO}_2$ as N commonly exceeded USEPA recommendations. Excessive nutrients in streams can be attributed to natural factors, like stream discharge (Mosley 2015) and springs (Converse 1994), but also human interactions with the landscape, like agriculture and urban development (Carpenter et al. 1998). Pastureland, cropland, and urban areas have steadily replaced forests within the Niangua River watershed over time (Schulz 2001). Over roughly a decade, forest has decreased by 1 percent, and agriculture and urban areas have collectively increased by 2.1 percent in the watershed (Table 1; USGS 2021, USGS 2014). These anthropogenic land uses can be non-point sources of nutrients during precipitation events (Carpenter et al. 2015). In the Niangua River, elevated nutrient levels were more prevalent in the spring, when precipitation tends to occur more frequently. Conversely, nutrient levels were lower in fall, when precipitation was lower and stream discharge was approximately 20 cfs below normal (USGS 2016).

Elevated nutrients have been found in the Niangua River in the past. Smale et al. (1995) collected nutrient parameters at the Charity MDC Access and Moon Valley MDC Access, both of which were sampled in the current study (sites 48.4 and 7.4, respectively). Their study reported elevated TN ($\bar{x} = 0.932$ mg/L, $n = 18$) and $\text{NO}_3 + \text{NO}_2$ as N ($\bar{x} = 0.264$ mg/L) levels at site 48.4 that were attributed to spring and groundwater influences. These influences appear to remain consistent, as site 48.4 had even higher nitrogen concentrations in 2022-2023 (mean TN = 1.08 mg/L, mean $\text{NO}_3 + \text{NO}_2$ as N = 1.01 mg/L, $n = 2$), which was the highest of the five locations sampled (Table 6, 7). Likewise, nitrogen levels increased at site 7.4 since the Smale et al. (1995) study (mean TN = 0.294 mg/L, mean $\text{NO}_3 + \text{NO}_2$ as N = 0.171 mg/L, $n = 12$; 2022-2023 mean TN = 0.385 mg/L, mean $\text{NO}_3 + \text{NO}_2$ as N = 0.285 mg/L, $n = 2$). Higher nutrients at both stations can likely be attributed to land use shifts since the 1990s.

5.3 Stream Habitat and Land Use

The quality of benthic habitat can be affected by surrounding land uses, especially agriculture (Stone et al. 2005). In this study, agricultural land uses were reflected in the SHAPP score of the control stream, the Little Niangua River. Although the Little Niangua River subwatershed had proportionally less agriculture (31.1 percent) than the study watershed (46.1 percent; Table 1), more farmland was present in the immediate riparian zone than the Niangua River. Consequently, poor riparian zone widths, bank instability, bank erosion, sediment deposition,

and little vegetative protection contributed to a SHAPP score that was lower than all Niangua River stations. Additionally, the Little Niangua River had several loosely consolidated gravel bars that suggested stream bed mobility. These gravel bars were less prevalent on the Niangua River, although evidence of regular fluctuations in water levels (e.g. woody debris and dislodged vegetation on the upper banks and trees) was present. Despite differences in riparian condition, the Little Niangua River had fair riffle quality, ample coarse substrate, and variable depth and flow regimes that were good benchmarks for the Niangua River.

The Big John MDC Access, station 28.7, had the lowest habitat quality of the Niangua River stations in this study. Natural factors and instream disturbances from recreation likely contributed to its score. Most of the sampled reach consisted of deeper pools; thus, compared to the other stations, station 28.7 had more fine substrates, poor riffle habitat, and more consistent depth and flow regimes. The Big John Access appeared to be the most-frequented MDC access sampled in this study, as foot trails, a boat ramp, and a human-made riffle were present. This riffle appeared to have been formed by people stacking cobble-sized rocks from both banks toward the middle of the channel. At base flow, the narrowed chute between these structures acted as a funnel through which the river's entire volume passed, which in turn created a shallow area downstream of the structures with higher velocity. The artificial riffle, though of high quality, was the only riffle that was present in the sampled reach.

6.0 Conclusions

The upper and middle Niangua River watershed (WBID 1170) sustained healthy macroinvertebrate communities and water quality that generally supported the beneficial use designation for the protection of warm water habitat. The macroinvertebrate communities were supportive of aquatic life, with high TR (208 taxa) and EPTT (71 EPTT, $n = 10$). Only one fall sample from the upstream-most site, 55.5, had a partially supporting MSCI score. The conditions of the communities were corroborated by good water quality, although nutrient parameters commonly exceeded criteria suggested by the USEPA. Despite these nutrient concentrations, SHAPP scores indicated excellent quality of habitat, which enabled diverse macroinvertebrate communities.

Continued changes in land use are perhaps the largest threat to the integrity of the Niangua River. As the landscape within the watershed shifts from forest to agricultural uses, biological communities and water quality will likely change. Routine assessments of water quality and macroinvertebrate communities should continue to monitor effects from nutrient enrichment and inform management responses.

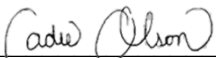
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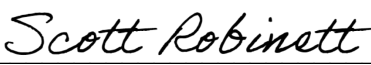
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Appendix A
Macroinvertebrate Database Bench Sheet Report
Fall 2022 and Spring 2023

Niangua River

Dallas and Webster Counties, Missouri

Grouped by Season and Station

Fall 2022 Bioassessment			
Sep 21, 2022 Niangua River - bl. State Hwy. Y [1170_55.5]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	6	4	
AMPHIPODA			
<i>Hyalella azteca</i>	1		196
BASOMMATOPHORA			
Ancylidae	3	1	1
<i>Menetus</i>			8
<i>Physella</i>		3	11
COLEOPTERA			
<i>Berosus</i>			3
<i>Dubiraphia</i>		1	7
<i>Ectopria nervosa</i>	2	1	
<i>Psephenus herricki</i>	42	6	
<i>Stenelmis</i>	27	18	1
<i>Tropisternus</i>			*
DECAPODA			
<i>Faxonius luteus</i>	1	*	
<i>Faxonius virilis</i>	2		2
DIPTERA			
<i>Ablabesmyia</i>	5	2	
Ceratopogoninae	1		
Chironomidae	4	2	1
<i>Chironomus</i>		5	
<i>Cladopelma</i>			1
<i>Cladotanytarsus</i>	1	9	
<i>Corynoneura</i>	1	2	
<i>Cricotopus/Orthocladius</i>	7	1	2
<i>Cryptochironomus</i>	2	3	

Sep 21, 2022 Niangua River - bl. State Hwy. Y [1170_55.5]			
<i>Dicrotendipes</i>	2	1	2
Ephydriidae	1		
Forcipomyiinae	3		
<i>Hemerodromia</i>	1		
<i>Hybomitra</i>	4		
<i>Labrundinia</i>	3		
<i>Paratanytarsus</i>			1
<i>Paratendipes</i>	2	2	
<i>Polypedilum flavum</i>	46		
<i>Polypedilum illinoense</i> grp	3	1	9
<i>Procladius</i>		1	
<i>Rheotanytarsus</i>	10		
<i>Stempellinella</i>	1	11	
<i>Tanytarsus</i>	13	7	3
<i>Thienemanniella</i>	7	1	
<i>Thienemannimyia</i> grp	18	1	1
<i>Tribelos</i>		1	
EPHEMEROPTERA			
<i>Acerpenna</i>	4		
<i>Baetis</i>	3		
Baetiscidae	1		
<i>Caenis anceps</i>	10		
<i>Caenis latipennis</i>	190	213	13
<i>Choroterpes</i>	4	4	1
<i>Ephemera</i>		*	
<i>Isonychia bicolor</i>	8		
<i>Procloeon</i>		5	1
<i>Stenacron</i>		4	
<i>Stenonema femoratum</i>	5	17	

Sep 21, 2022 Niangua River - bl. State Hwy. Y [1170_55.5]			
<i>Stenonema mediopunctatum</i>	1		
<i>Stenonema pulchellum</i>	19		
<i>Tricorythodes</i>	51	3	
HEMIPTERA			
<i>Microvelia</i>	1		
LUMBRICINA			
Lumbricina	3	1	
MEGALOPTERA			
<i>Corydalus</i>	1		
<i>Nigronia serricornis</i>	1		
NEOTAENIOGLOSSA			
<i>Elimia</i>	5	3	26
ODONATA			
<i>Argia</i>	10	3	10
<i>Basiaeschna janata</i>			*
<i>Enallagma</i>			47
<i>Hagenius brevistylus</i>		*	1
<i>Stylogomphus sigmastylus</i>		*	
PLECOPTERA			
<i>Leuctra</i>	1		
<i>Perlidae</i>	1		
TRICHOPTERA			
<i>Cheumatopsyche</i>	58	1	1
<i>Chimarra</i>	5		
<i>Helicopsyche</i>	1		
<i>Hydroptila</i>	2		
<i>Oecetis</i>			1
<i>Triaenodes</i>			2
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
<i>Branchiura sowerbyi</i>		2	
Tubificinae	2	4	

Sep 21, 2022 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	15	3	
AMPHIPODA			
<i>Hyaella azteca</i>			61
BASOMMATOPHORA			
Ancylidae	1		
<i>Menetus</i>			1
<i>Physella</i>	1		3
COLEOPTERA			
<i>Dubiraphia</i>			11
<i>Ectopria nervosa</i>	2	14	1
<i>Helichus lithophilus</i>			1
<i>Macronychus glabratus</i>			1
<i>Psephenus herricki</i>	7	4	1
<i>Stenelmis</i>	2	15	
<i>Tropisternus</i>			*
DECAPODA			
<i>Faxonius luteus</i>	*		*
<i>Faxonius virilis</i>			*
DIPTERA			
<i>Ablabesmyia</i>		2	1
Ceratopogoninae		1	
Chironomidae	2	2	
<i>Cladotanytarsus</i>		11	1
<i>Cricotopus/Orthocladus</i>	3	8	6
<i>Cryptochironomus</i>		4	
<i>Dicrotendipes</i>		5	4
Empididae (undescribed)	1		
<i>Hexatoma</i>		1	
<i>Labrundinia</i>			1
<i>Microtendipes</i>	2	3	
<i>Paralauterborniella</i>			1
<i>Parametriocnemus</i>	1		
<i>Paratanytarsus</i>	1	1	3
<i>Pentaneura</i>			1
<i>Polypedilum flavum</i>	8	8	1
<i>Polypedilum illinoense</i> grp	1	1	

Sep 21, 2022 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
<i>Polypedilum scalaenum</i> grp		1	
<i>Rheotanytarsus</i>	13	13	4
<i>Simulium</i>	1		
<i>Stempellinella</i>	1	6	
<i>Tanytarsus</i>	2	5	4
<i>Thienemanniella</i>	1		
<i>Thienemannimyia</i> grp	5	7	2
<i>Tvetenia bavarica</i> grp	2		
EPHEMEROPTERA			
<i>Acentrella</i>	3		
<i>Anthopotamus</i>	1	4	
<i>Baetis</i>	99		
<i>Baetisca lacustris</i>	1	1	
<i>Caenis anceps</i>	59	35	
<i>Caenis latipennis</i>	7	93	18
<i>Choroterpes</i>		5	
<i>Ephemera simulans</i>		3	
<i>Isonychia bicolor</i>	49		
<i>Labiobaetis</i>			1
Leptophlebiidae		3	6
<i>Leucrocuta</i>	3	1	
<i>Procloeon</i>		4	
<i>Stenacron</i>	1	1	
<i>Stenonema femoratum</i>		4	
<i>Stenonema mediopunctatum</i>	9		
<i>Stenonema pulchellum</i>	15		
<i>Stenonema terminatum</i>	15	1	
<i>Tricorythodes</i>	37	31	
ISOPODA			
<i>Caecidotea</i> (Blind & Unpigmented)		1	
LEPIDOPTERA			
<i>Petrophila</i>	1		
LUMBRICINA			
Lumbricina	1	3	
MEGALOPTERA			
<i>Corydalus</i>	4		
<i>Nigronia serricornis</i>		*	

Sep 21, 2022 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
<i>Sialis</i>			1
NEOTAENIOGLOSSA			
<i>Elimia</i>	30	2	115
Hydrobiidae		6	
ODONATA			
<i>Argia</i>			3
<i>Basiaeschna janata</i>			2
<i>Calopteryx</i>			6
<i>Enallagma</i>			5
Gomphidae	1	1	
<i>Hetaerina</i>			1
TRICHOPTERA			
<i>Agapetus</i>	5		
<i>Cheumatopsyche</i>	63		
<i>Chimarra</i>	1		
<i>Helicopsyche</i>	29	1	
<i>Hydropsyche morosa</i> grp	41		
<i>Oecetis</i>		1	2
<i>Psychomyia</i>	3		
<i>Triaenodes</i>			12
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Tubificinae		2	

Sep 20, 2022 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	4	2	
AMPHIPODA			
<i>Hyalella azteca</i>			114
BASOMMATOPHORA			
Ancylidae		1	
<i>Menetus</i>			12
BRANCHIOBELLELLIDA			

Sep 20, 2022 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
Branchiobdellida	2		
COLEOPTERA			
<i>Dubiraphia</i>	1	3	10
<i>Ectopria nervosa</i>	1	14	2
<i>Macronychus glabratus</i>			3
<i>Psephenus herricki</i>	5	25	1
<i>Stenelmis</i>	15	40	
DECAPODA			
<i>Faxonius luteus</i>	3	2	
<i>Faxonius virilis</i>			*
DIPTERA			
<i>Ablabesmyia</i>		8	
<i>Atherix</i>	*		
Chironomidae			
<i>Cladotanytarsus</i>		3	
<i>Cricotopus/Orthocladius</i>	4	5	17
<i>Cryptochironomus</i>		4	
<i>Dicrotendipes</i>	1	2	
<i>Hexatoma</i>	1	2	
<i>Lopescladius</i>	3		
<i>Paralauterborniella</i>		1	
<i>Paratanytarsus</i>	1		
<i>Polypedilum flavum</i>	18		
<i>Polypedilum halterale</i> grp	3	1	
<i>Polypedilum scalaenum</i> grp	1	8	
<i>Procladius</i>		1	
<i>Rheotanytarsus</i>	3		1
<i>Simulium</i>	2		
<i>Stempellinella</i>	12	7	2
<i>Tanytarsus</i>	2	1	5
<i>Thienemanniella</i>	4		
<i>Thienemannimyia</i> grp	2	1	
EPHEMEROPTERA			
<i>Acentrella</i>	2		
<i>Acerpenna</i>	8		
<i>Anthopotamus</i>	6	22	
<i>Apobaetis</i>		1	
<i>Baetis</i>	33		

Sep 20, 2022 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
Baetiscidae	2	2	
<i>Caenis anceps</i>	46	28	
<i>Caenis latipennis</i>		5	2
<i>Choroterpes</i>	4	30	
<i>Ephemera</i>	7	25	
<i>Hexagenia limbata</i>		2	
<i>Isonychia bicolor</i>	38		
<i>Leucrocuta</i>	23	1	
<i>Procloeon</i>	2	11	
<i>Stenacron</i>	65	75	
<i>Stenonema femoratum</i>	1	16	
<i>Stenonema mediopunctatum</i>	32		
<i>Stenonema pulchellum</i>	38	3	
<i>Tricorythodes</i>	130	4	1
ISOPODA			
<i>Caecidotea</i> (Blind & Unpigmented)		5	
LEPIDOPTERA			
<i>Petrophila</i>	1		
LUMBRICINA			
Lumbricina	4		
MEGALOPTERA			
<i>Corydalus</i>	7		
<i>Sialis</i>		1	
NEOTAENIOGLOSSA			
<i>Elimia</i>	26	36	82
Hydrobiidae	1		
ODONATA			
<i>Argia</i>	1	8	13
<i>Enallagma</i>			39
Gomphidae	*	1	
PLECOPTERA			
<i>Neoperla</i>	9	4	
<i>Perlinella drymo</i>		2	
TRICHOPTERA			
<i>Cernotina</i>		1	
<i>Cheumatopsyche</i>	4		
<i>Helicopsyche</i>	3		

Sep 20, 2022 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
<i>Nectopsyche</i>		1	1
<i>Triaenodes</i>			1
TRICLADIDA			
Planariidae	1		1
TUBIFICIDA			
<i>Aulodrilus</i>			1
<i>Branchiura sowerbyi</i>		10	
<i>Limnodrilus hoffmeisteri</i>		1	
Tubificinae		5	
VENEROIDA			
<i>Corbicula</i>	16	*	1

Sep 20, 2022 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	13	2	1
BASOMMATOPHORA			
Ancylidae	3	9	2
<i>Menetus</i>			32
<i>Physella</i>			1
COLEOPTERA			
<i>Dubiraphia</i>		7	41
<i>Ectopria nervosa</i>	1	6	1
<i>Helichus basalis</i>			4
<i>Helichus lithophilus</i>		1	24
<i>Macronychus glabratus</i>		1	13
<i>Psephenus herricki</i>	3	14	
<i>Stenelmis</i>	11	11	
DECAPODA			
<i>Faxonius luteus</i>	*		
DIPTERA			
<i>Ablabesmyia</i>		4	1
<i>Atherix</i>	1		
<i>Chrysops</i>		3	
<i>Cladotanytarsus</i>		2	

Sep 20, 2022 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
<i>Cricotopus/Orthocladius</i>	4	2	1
<i>Cryptochironomus</i>		1	
<i>Cryptotendipes</i>		9	
<i>Dicrotendipes</i>	1	7	1
<i>Forcipomyiinae</i>			1
<i>Hexatoma</i>	2	1	
<i>Lopescladius</i>	5		
<i>Parametriocnemus</i>	2		
<i>Polypedilum flavum</i>	9	1	1
<i>Polypedilum halterale</i> grp	1	3	1
<i>Polypedilum scalaenum</i> grp	2	2	1
<i>Rheotanytarsus</i>	6		3
<i>Simulium</i>	1		1
<i>Stempellinella</i>		9	
<i>Stenochironomus</i>		2	
<i>Tabanus</i>	1		
<i>Tanytarsus</i>	1	26	3
<i>Thienemanniella</i>	1		
<i>Thienemannimyia</i> grp	1	2	1
EPHEMEROPTERA			
<i>Acerpenna</i>	8		
<i>Anthopotamus</i>	6	7	
<i>Baetis</i>	27		
<i>Baetisca lacustris</i>		7	
<i>Caenis anceps</i>	6	43	1
<i>Caenis latipennis</i>		24	
<i>Choroterpes</i>		23	
<i>Ephemera</i>	2	1	
<i>Isonychia bicolor</i>	23		
<i>Labiobaetis</i>			2
<i>Leucrocuta</i>	21	2	
<i>Procloeon</i>		6	
<i>Stenacron</i>		13	1
<i>Stenonema femoratum</i>		12	
<i>Stenonema mediopunctatum</i>	43		
<i>Stenonema pulchellum</i>	39	5	1
<i>Stenonema terminatum</i>		2	1

Sep 20, 2022 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
<i>Tricorythodes</i>	80	7	13
LEPIDOPTERA			
<i>Petrophila</i>	2		
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
<i>Corydalus</i>	7		
NEOTAENIOGLOSSA			
<i>Elimia</i>	210	20	168
Hydrobiidae	1		16
ODONATA			
<i>Argia</i>	1	4	7
<i>Enallagma</i>			47
Gomphidae		1	
<i>Gomphurus</i>		1	
<i>Macromia</i>		1	2
<i>Stylogomphus sigmastylus</i>	1		
PLECOPTERA			
<i>Acroneuria</i>	*		
<i>Neoperla</i>	16	8	
<i>Perlinella ephyre</i>	*		
<i>Pteronarcys pictetii</i>			*
TRICHOPTERA			
<i>Cernotina</i>		2	
<i>Cheumatopsyche</i>	2		
<i>Helicopsyche</i>	8		
<i>Hydropsyche</i>			1
Hydroptilidae	1		
<i>Nectopsyche</i>		1	
<i>Oecetis</i>			1
<i>Protoptila</i>	1		
<i>Triaenodes</i>			3
TUBIFICIDA			
<i>Branchiura sowerbyi</i>		3	
Tubificinae		3	2
VENEROIDA			
<i>Corbicula</i>	15	4	

Sep 20, 2022 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	3	1	
AMPHIPODA			
<i>Hyaella azteca</i>		1	28
BASOMMATOPHORA			
Ancylidae	1	2	1
COLEOPTERA			
<i>Dubiraphia</i>		1	12
<i>Ectopria nervosa</i>		2	
<i>Helichus lithophilus</i>			3
<i>Optioservus sandersoni</i>	2		
<i>Psephenus herricki</i>	13	5	
Scirtidae			1
<i>Stenelmis</i>	9	16	
DECAPODA			
<i>Faxonius luteus</i>	1		
DIPTERA			
<i>Ablabesmyia</i>		13	8
Ceratopogoninae		1	
Chironomidae	2		
<i>Corynoneura</i>		1	
<i>Cricotopus/Orthocladus</i>	1	3	10
<i>Cryptochironomus</i>	1	2	
<i>Dicrotendipes</i>		8	1
<i>Hexatoma</i>	1	*	
<i>Hybomitra</i>	1		
<i>Labrundinia</i>			2
<i>Microtendipes</i>	2		
<i>Nilothauma</i>		1	
<i>Paratanytarsus</i>		1	1
<i>Phaenopsectra</i>		1	
<i>Polypedilum fallax</i> grp	2		
<i>Polypedilum flavum</i>	41	1	3
<i>Polypedilum illinoense</i> grp			1
<i>Polypedilum scalaenum</i> grp	1	3	
<i>Pseudochironomus</i>		2	1

Sep 20, 2022 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
<i>Rheotanytarsus</i>	4	4	5
<i>Simulium</i>	1		1
<i>Stempellinella</i>	3	35	
<i>Synorthocladius</i>		3	
<i>Tabanus</i>		*	
<i>Tanytarsus</i>		24	2
<i>Thienemanniella</i>	1	2	
<i>Thienemannimyia</i> grp			1
EPHEMEROPTERA			
<i>Acerpenna</i>	5		
<i>Anthopotamus</i>	18	7	
<i>Baetis</i>	30		
<i>Baetiscidae</i>		2	
<i>Caenis anceps</i>	8	20	2
<i>Choroterpes</i>	1	4	
<i>Ephemera</i>	1	*	
<i>Isonychia bicolor</i>	17		
<i>Leucrocuta</i>	53	2	
<i>Proclleon</i>		3	1
<i>Stenacron</i>	8	22	1
<i>Stenonema mediopunctatum</i>	14		
<i>Stenonema pulchellum</i>	5	4	1
<i>Tricorythodes</i>	84	13	12
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
<i>Corydalus</i>	2		
NEOTAENIOGLOSSA			
<i>Elimia</i>	166	39	166
Hydrobiidae	2		1
ODONATA			
<i>Argia</i>	1	5	4
Corduliidae			1
<i>Enallagma</i>			9
Gomphidae		1	
<i>Gomphurus</i>		*	
<i>Hagenius brevistylus</i>		2	
<i>Hetaerina</i>			1

Sep 20, 2022 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
<i>Macromia</i>		*	
<i>Stylogomphus sigmastylus</i>		*	
PLECOPTERA			
<i>Neoperla</i>	37	2	
TRICHOPTERA			
<i>Cernotina</i>		3	
<i>Cheumatopsyche</i>	9		
<i>Chimarra</i>	3		
<i>Helicopsyche</i>	53	3	1
<i>Hydroptila</i>		8	1
<i>Leptoceridae</i>			1
<i>Nectopsyche</i>		5	
<i>Oecetis</i>	3	3	
TUBIFICIDA			
<i>Branchiura sowerbyi</i>		2	
VENEROIDA			
<i>Corbicula</i>	17	7	

Spring 2023 Bioassessment

Apr 10, 2023 Niangua River - bl. State Hwy. Y [1170_55.5]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	2	4	
AMPHIPODA			
<i>Crangonyx</i>	4	8	12
<i>Hyaella azteca</i>		1	
BRANCHIOBELLELLIDA			
Branchiobdellida	4		*
COLEOPTERA			
<i>Agabus</i>			1
<i>Dubiraphia</i>	1	4	
Dytiscidae		1	
<i>Hydraena</i>	1	1	
<i>Psephenus herricki</i>	16	6	1
<i>Stenelmis</i>	36	27	4

Apr 10, 2023 Niangua River - bl. State Hwy. Y [1170_55.5]			
DECAPODA			
<i>Faxonius luteus</i>	1	*	*
DIPTERA			
<i>Ablabesmyia</i>		4	
<i>Brillia</i>		1	
Ceratopogoninae	2	4	
Chironomidae		4	3
<i>Chironomus</i>		1	
<i>Corynoneura</i>		8	5
<i>Cricotopus bicinctus</i>			2
<i>Cricotopus/Orthocladius</i>	13	21	58
<i>Dicrotendipes</i>		2	2
<i>Eukiefferiella</i>	80	12	74
<i>Hemerodromia</i>			1
<i>Hexatoma</i>		*	
<i>Hydrobaenus</i>		7	
<i>Micropsectra</i>	11	3	12
<i>Parametriocnemus</i>	5		2
<i>Paratanytarsus</i>			1
<i>Paratendipes</i>		6	
<i>Phaenopsectra</i>		1	
<i>Polypedilum aviceps</i>			2
<i>Polypedilum flavum</i>	16		2
<i>Prosimulium</i>	1		
<i>Rheocricotopus</i>	1		
<i>Rheotanytarsus</i>	1		1
<i>Roederiodes</i>	1		
<i>Simulium</i>	6		1
<i>Stictochironomus</i>		2	
<i>Sympotthastia</i>	1		
<i>Synorthocladius</i>			1
<i>Tabanus</i>	*		
<i>Tanytarsus</i>	3	3	
<i>Thienemanniella</i>	1	2	3
<i>Thienemannimyia</i> grp	2	11	2
<i>Tipula</i>	1		*
<i>Trichoclinocera</i>	9	2	
<i>Tvetenia bavarica</i> grp	4		2
EPHEMEROPTERA			

Apr 10, 2023 Niangua River - bl. State Hwy. Y [1170_55.5]			
<i>Acentrella</i>	56	1	10
<i>Acerpenna</i>	4		
<i>Caenis anceps</i>	6	29	1
<i>Caenis latipennis</i>	69	59	115
<i>Ephemerella needhami</i>			1
<i>Isonychia bicolor</i>	4		
<i>Leucrocuta</i>	64	20	
<i>Paraleptophlebia</i>		2	2
<i>Plauditus</i>	30		1
<i>Siphonurus</i>			*
<i>Stenacron</i>	2	1	
<i>Stenonema femoratum</i>	4	7	
<i>Stenonema pulchellum</i>	17	1	*
<i>Stenonema terminatum</i>			*
<i>Tricorythodes</i>			2
ISOPODA			
<i>Caecidotea</i> (Blind & Unpigmented)		2	
LUMBRICINA			
Lumbricina	1	4	
LUMBRICULIDA			
Lumbriculidae		1	
MEGALOPTERA			
<i>Corydalus</i>	*		
<i>Nigronia serricornis</i>			1
NEOTAENIOGLOSSA			
<i>Elimia</i>	5	1	7
ODONATA			
<i>Argia</i>	4		3
<i>Enallagma</i>			10
Gomphidae			1
<i>Hagenius brevistylus</i>		1	
<i>Ophiogomphus</i>	3		
PLECOPTERA			
<i>Amphinemura</i>	32		2
<i>Haploperla</i>	10	8	
<i>Isoperla</i>	11	1	
<i>Perlesta</i>	71	1	1
<i>Zealeuctra</i>		3	

Apr 10, 2023 Niangua River - bl. State Hwy. Y [1170_55.5]			
TRICHOPTERA			
<i>Cheumatopsyche</i>	1		
<i>Chimarra</i>	1		
<i>Helicopsyche</i>	1		
<i>Hydroptila</i>	4		
<i>Ironoquia</i>			*
<i>Pycnopsyche</i>			*
<i>Rhyacophila</i>	1		
<i>Triaenodes</i>			1
TRICLADIDA			
Planariidae	5		
TUBIFICIDA			
<i>Branchiura sowerbyi</i>		3	
<i>Limnodrilus hoffmeisteri</i>		1	
Tubificinae	1	2	

Apr 10, 2023 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	2	3	
AMPHIPODA			
<i>Crangonyx</i>	3	1	3
<i>Gammarus</i>	*		11
<i>Hyaella azteca</i>			5
BASOMMATOPHORA			
<i>Physella</i>	1		
COLEOPTERA			
<i>Dubiraphia</i>		1	1
<i>Ectopria nervosa</i>		2	
<i>Hydraena</i>	1		
<i>Neoporus</i>		1	
<i>Psephenus herricki</i>	12	4	
<i>Stenelmis</i>	8	36	2
DECAPODA			
<i>Faxonius luteus</i>		*	

Apr 10, 2023 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
DIPTERA			
<i>Ablabesmyia</i>		4	1
Ceratopogonidae	4	6	
Chironomidae		1	
<i>Cladotanytarsus</i>		25	1
<i>Corynoneura</i>		4	
<i>Cricotopus/Orthocladius</i>	14	29	8
<i>Dicrotendipes</i>		2	
Empididae (undescribed)		1	
Ephydriidae		1	
<i>Eukiefferiella</i>	26	11	9
<i>Hemerodromia</i>	1		
<i>Hexatoma</i>		5	
<i>Hydrobaenus</i>		4	
<i>Micropsectra</i>	6	8	2
<i>Parametriocnemus</i>		1	
<i>Paratanytarsus</i>	1		
<i>Paratendipes</i>	1	4	
<i>Polypedilum flavum</i>	2	1	1
<i>Polypedilum scalaenum</i> grp		1	
<i>Pseudolimnophila</i>		1	
<i>Rheotanytarsus</i>	1	1	11
<i>Simulium</i>	2		
<i>Stempellinella</i>		3	
<i>Stictochironomus</i>		2	
<i>Sympotthastia</i>	1		
<i>Synorthocladius</i>			1
<i>Tanytarsus</i>		4	
<i>Thienemannimyia</i> grp	1	5	1
<i>Trichoclinocera</i>	4	1	
EPHEMEROPTERA			
<i>Acentrella</i>	6		
<i>Caenis latipennis</i>	16	67	14
<i>Ephemerella invaria</i>	2	1	
<i>Eurylophella bicolor</i>		2	3
<i>Isonychia</i>	1		
Leptophlebiidae		1	
<i>Leucrocota</i>	7	1	
<i>Plauditus</i>	29	1	4

Apr 10, 2023 Niangua River - bl. State Rd. M @ Charity Access [1170_48.4]			
<i>Proclodeon</i>	1		
<i>Stenacron</i>	1		
<i>Stenonema femoratum</i>	5	7	
<i>Stenonema pulchellum</i>	5	3	
LUMBRICINA			
Lumbricina	1	4	
MEGALOPTERA			
<i>Nigronia serricornis</i>	*		
NEOTAENIOGLOSSA			
<i>Elimia</i>	92	1	275
ODONATA			
<i>Argia</i>	*		
<i>Basiaeschna janata</i>			*
<i>Calopteryx</i>			1
<i>Enallagma</i>			1
<i>Stylogomphus sigmastylus</i>			*
PLECOPTERA			
<i>Amphinemura</i>	1		2
<i>Isoperla</i>	1		
<i>Neoperla</i>	1	1	
<i>Perlesta</i>	18	3	7
<i>Pteronarcys pictetii</i>	1		
TRICHOPTERA			
<i>Cheumatopsyche</i>	2		2
<i>Glossosoma</i>	45		
<i>Helicopsyche</i>	3	2	1
<i>Hydropsyche</i>			*
<i>Mystacides</i>		1	
<i>Plectrocnemia</i>		1	
<i>Pycnopsyche</i>			*
TRICLADIDA			
Planariidae	3		
TUBIFICIDA			
<i>Branchiura sowerbyi</i>	1		
<i>Limnodrilus hoffmeisteri</i>		1	
Tubificinae	2	1	
VENEROIDA			
<i>Corbicula</i>	1		

Apr 10, 2023 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	23		1
AMPHIPODA			
<i>Crangonyx</i>	1		
<i>Hyalella azteca</i>			7
BASOMMATOPHORA			
Ancylidae		1	
COLEOPTERA			
<i>Dubiraphia</i>		2	2
<i>Gyrinus</i>			1
<i>Helichus fastigiatus</i>	1		
<i>Helichus lithophilus</i>			1
<i>Macronychus glabratus</i>			2
<i>Psephenus herricki</i>	15	2	1
<i>Stenelmis</i>	33	6	
DECAPODA			
<i>Faxonius luteus</i>	1	*	*
DIPTERA			
<i>Ablabesmyia</i>		5	8
Ceratopogoninae	1	3	
Chironomidae	2	4	
<i>Chrysops</i>		*	
<i>Cladotanytarsus</i>	1	84	
<i>Corynoneura</i>		1	
<i>Cricotopus/Orthocladius</i>	30	17	28
<i>Cryptochironomus</i>		7	
<i>Cryptotendipes</i>		15	
<i>Dicrotendipes</i>		5	1
<i>Diptera</i>		1	
<i>Erioptera</i>		1	
<i>Eukiefferiella</i>	9	1	
<i>Hemerodromia</i>	3		
<i>Hexatoma</i>	*	*	
<i>Hydrobaenus</i>		1	3
<i>Kribiodorum perpulchrum</i>			1
<i>Labrundinia</i>			3
<i>Lopescladius</i>	3		

Apr 10, 2023 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
<i>Micropsectra</i>			1
<i>Microtendipes</i>	2	1	
<i>Nanocladius</i>	1		
<i>Paracladopelma</i>		7	
<i>Paralauterborniella</i>		5	
<i>Paratanytarsus</i>	1		2
<i>Polypedilum flavum</i>	10	2	
<i>Polypedilum scalaenum</i> grp	2	6	1
<i>Procladius</i>		4	
<i>Prosimulium</i>	1		
<i>Rheotanytarsus</i>	6		3
<i>Simulium</i>	40		
<i>Stempellina</i>		3	
<i>Stempellinella</i>	7	13	1
<i>Stictochironomus</i>		13	
<i>Synorthocladius</i>	1		
<i>Tabanus</i>	2		
<i>Tanytarsus</i>		23	8
<i>Thienemanniella</i>	1		
<i>Thienemannimyia</i> grp	4	7	
EPHEMEROPTERA			
<i>Acentrella</i>	14		
<i>Acerpenna</i>	2		
<i>Anthopotamus</i>	15	2	
<i>Baetis</i>	3		
<i>Baetisca lacustris</i>	5	1	1
<i>Caenis latipennis</i>	9	21	14
<i>Ephemera simulans</i>	1	3	
<i>Ephemerella invaria</i>	16	1	
<i>Ephemerella needhami</i>	11	4	
<i>Eurylophella bicolor</i>	2	1	2
<i>Heptagenia</i>	1		
<i>Hexagenia limbata</i>		*	1
<i>Isonychia bicolor</i>	14		
<i>Leptophlebia</i>		*	
<i>Leucrocuta</i>	5	2	1
<i>Paraleptophlebia</i>			3
<i>Plauditus</i>	3		
<i>Rhithrogena</i>	38		

Apr 10, 2023 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
<i>Siphonurus</i>			2
<i>Stenacron</i>	1	4	
<i>Stenonema femoratum</i>	7	*	4
<i>Stenonema mediopunctatum</i>	17		
<i>Stenonema pulchellum</i>	6	3	
<i>Stenonema terminatum</i>	1		1
<i>Tricorythodes</i>	30	2	
LUMBRICINA			
Lumbricina	6	1	1
MEGALOPTERA			
<i>Corydalus</i>	5		
NEOTAENIOGLOSSA			
<i>Elimia</i>	112	*	137
Hydrobiidae		1	1
ODONATA			
<i>Calopteryx</i>			1
<i>Dromogomphus</i>			*
<i>Enallagma</i>			13
Gomphidae		1	
<i>Hagenius brevistylus</i>		1	
PLECOPTERA			
<i>Amphinemura</i>	1		
<i>Haploperla</i>	4	1	
<i>Isoperla</i>	1		
<i>Neoperla</i>	15	3	
<i>Perlesta</i>	10		
<i>Perlinella ephyre</i>		*	
<i>Pteronarcys pictetii</i>	6		
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
<i>Ceraclea</i>	1		
<i>Cheumatopsyche</i>	5		
<i>Chimarra</i>	1		
Glossosomatidae	3		
<i>Helicopsyche</i>	12		1
<i>Hydroptila</i>	2		
<i>Neophylax</i>	1		

Apr 10, 2023 Niangua River - bl. Steelman Rd. @ Big John Access [1170_28.7]			
<i>Oecetis</i>	1		1
<i>Pycnopsyche</i>	1		1
TUBIFICIDA			
<i>Ilyodrilus templetoni</i>		1	
<i>Limnodrilus hoffmeisteri</i>	3	10	
Tubificinae	3	20	1
UNIONIDA			
Unionidae		*	
VENEROIDA			
<i>Corbicula</i>	6		1
Pisidiidae	1	2	

Apr 11, 2023 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	12	10	
AMPHIPODA			
<i>Crangonyx</i>	1		
<i>Hyaella azteca</i>			2
BASOMMATOPHORA			
Ancylidae		2	
BRANCHIOBELLELLIDA			
Branchiobdellida			1
COLEOPTERA			
<i>Dubiraphia</i>	1		1
<i>Helichus lithophilus</i>			2
<i>Macronychus glabratus</i>			2
<i>Psephenus herricki</i>	6	2	1
<i>Stenelmis</i>	17		1
DECAPODA			
<i>Faxonius luteus</i>	*		6
<i>Faxonius virilis</i>			*
DIPTERA			
<i>Ablabesmyia</i>		11	
Ceratopogoninae	11	2	

Apr 11, 2023 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
Chironomidae		1	1
<i>Cladotanytarsus</i>	10	57	4
<i>Corynoneura</i>		6	1
<i>Cricotopus/Orthocladius</i>	12	10	10
<i>Cryptochironomus</i>	4	4	
<i>Dicrotendipes</i>	1	7	
Diptera	1	1	
<i>Eukiefferiella</i>	13	1	3
<i>Glyptotendipes</i>		1	
<i>Hemerodromia</i>	1	1	
<i>Hexatoma</i>	3		
<i>Hydrobaenus</i>		3	
<i>Labrundinia</i>			1
<i>Lopescladius</i>	2		
<i>Micropsectra</i>			1
<i>Microtendipes</i>	1		1
<i>Parakiefferiella</i>		5	4
<i>Parametriocnemus</i>	4		
<i>Paratanytarsus</i>		2	4
<i>Phaenopsectra</i>		1	
<i>Polypedilum flavum</i>	13	2	
<i>Polypedilum halterale</i> grp	1	1	
<i>Polypedilum illinoense</i> grp		1	1
<i>Polypedilum scalaenum</i> grp	3		
<i>Rheocricotopus</i>	1		
<i>Rheotanytarsus</i>	4	2	5
<i>Robackia</i>	3		
<i>Simulium</i>	11	1	21
<i>Stempellinella</i>	4	10	5
<i>Stictochironomus</i>	1	1	
<i>Synorthocladius</i>	1	2	
<i>Tabanus</i>	1		
<i>Tanytarsus</i>		27	12
<i>Thienemanniella</i>			1
<i>Thienemannimyia</i> grp	4	1	1
<i>Tipula</i>			1
<i>Tribelos</i>		1	
EPHEMEROPTERA			
<i>Acentrella</i>	2		3

Apr 11, 2023 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
<i>Acerpenna</i>	6		3
<i>Anthopotamus</i>	13	2	
<i>Baetis</i>	4		1
<i>Baetisca lacustris</i>	2	1	8
<i>Caenis anceps</i>	1		
<i>Caenis latipennis</i>	11	18	22
<i>Ephemerella invaria</i>		*	
<i>Ephemerella needhami</i>	8		19
<i>Eurylophella bicolor</i>		2	2
<i>Isonychia bicolor</i>	6		2
<i>Leucrocota</i>	2	1	
<i>Plauditus</i>	19		9
<i>Rhithrogena</i>	48		
<i>Siphonurus</i>			*
<i>Stenacron</i>	1	1	1
<i>Stenonema femoratum</i>	1	8	2
<i>Stenonema mediopunctatum</i>	10		
<i>Stenonema pulchellum</i>	9		
<i>Stenonema terminatum</i>			1
<i>Tricorythodes</i>	20	2	22
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
<i>Corydalus</i>	1		
NEOTAENIOGLOSSA			
<i>Elimia</i>	94	6	25
Hydrobiidae			1
ODONATA			
<i>Argia</i>		1	
<i>Calopteryx</i>			1
<i>Enallagma</i>			7
<i>Macromia</i>		*	
PLECOPTERA			
<i>Acroneuria</i>	1		
<i>Amphinemura</i>			1
<i>Haploperla</i>	7		
<i>Isoperla</i>	5		
<i>Neoperla</i>	21		
<i>Perlesta</i>	21	1	31

Apr 11, 2023 Niangua River - bl. Benton Branch Rd. @ Wms. Ford Access [1170_17.7]			
<i>Pteronarcys pictetii</i>	2		2
TRICHOPTERA			
<i>Helicopsyche</i>	15		
<i>Hydroptila</i>	3		1
<i>Oecetis</i>	1	3	
<i>Protophila</i>	4		
TUBIFICIDA			
<i>Branchiura sowerbyi</i>		2	
<i>Limnodrilus hoffmeisteri</i>	3	3	
Tubificinae	8	10	2
VENEROIDA			
<i>Corbicula</i>	1	1	
Pisidiidae	3	1	

Apr 11, 2023 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
* Large/Rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	13	7	
AMPHIPODA			
<i>Crangonyx</i>	1		
<i>Hyalella azteca</i>			16
COLEOPTERA			
Dytiscidae		1	
<i>Helichus lithophilus</i>	1		
<i>Macronychus glabratus</i>		2	1
<i>Optioservus sandersoni</i>		1	
<i>Psephenus herricki</i>	1		
<i>Stenelmis</i>	10	33	
DECAPODA			
<i>Faxonius luteus</i>		*	*
DIPTERA			
<i>Ablabesmyia</i>		29	4
Ceratopogonidae	7	9	
<i>Chrysops</i>		1	
<i>Cladotanytarsus</i>	5	13	

Apr 11, 2023 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
<i>Corynoneura</i>	3	6	1
<i>Cricotopus/Orthocladius</i>	29	12	
<i>Cryptochironomus</i>		2	
<i>Cryptotendipes</i>		4	1
<i>Dicrotendipes</i>		4	
<i>Erioptera</i>		1	
<i>Eukiefferiella</i>	8	3	
<i>Hemerodromia</i>	1	1	
<i>Hexatoma</i>	2	2	
<i>Hydrobaenus</i>		4	
<i>Labrundinia</i>			1
<i>Limnophila</i>		1	
<i>Micropsectra</i>	4	5	4
<i>Microtendipes</i>	1	2	
<i>Paralauterborniella</i>		1	1
<i>Parametriocnemus</i>	2		
<i>Paratanytarsus</i>	2		
<i>Polypedilum flavum</i>	24	2	
<i>Polypedilum halterale</i> grp		2	
<i>Polypedilum scalaenum</i> grp		3	
<i>Polypedilum tritum</i>		2	
<i>Procladius</i>		1	
<i>Pseudochironomus</i>	3		
<i>Rheotanytarsus</i>	2	1	9
<i>Simulium</i>	12	2	
<i>Stempellinella</i>	5	13	
<i>Stenochironomus</i>			1
<i>Sympotthastia</i>	2	1	
<i>Tanytarsus</i>	9	44	6
<i>Thienemannimyia</i> grp	6	7	
EPHEMEROPTERA			
<i>Acentrella</i>	2	*	
<i>Anthopotamus</i>	43	8	
<i>Baetisca lacustris</i>		2	
<i>Caenis anceps</i>		5	
<i>Caenis latipennis</i>	17	26	5
<i>Ephemera simulans</i>	1	2	
<i>Ephemerella needhami</i>	3		
<i>Eurylophella</i>	1		

Apr 11, 2023 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
<i>Eurylophella bicolor</i>	2	2	*
<i>Hexagenia</i>		1	1
<i>Isonychia bicolor</i>	2	2	
<i>Leucrocuta</i>	10	5	
<i>Plauditus</i>	9	1	
<i>Rhithrogena</i>	34		
<i>Stenacron</i>	6	2	
<i>Stenonema femoratum</i>	3	4	3
<i>Stenonema mediopunctatum</i>	2		*
<i>Stenonema pulchellum</i>	4		
<i>Tricorythodes</i>	11	3	
LUMBRICINA			
Lumbricina	2	1	
NEOTAENIOGLOSSA			
<i>Elimia</i>	7	3	198
ODONATA			
<i>Argia</i>	1	1	
<i>Enallagma</i>		3	5
Gomphidae	1		
<i>Hetaerina</i>			*
Macromiidae			1
PLECOPTERA			
<i>Haploperla</i>	1		
<i>Neoperla</i>	21	4	
<i>Perlesta</i>	8	2	1
<i>Perlinella ephyre</i>	1	*	
<i>Pteronarcys pictetii</i>	1		
TRICHOPTERA			
<i>Cheumatopsyche</i>	2		
<i>Chimarra</i>	*		
<i>Hydroptila</i>		2	3
<i>Nectopsyche</i>	1	4	3
<i>Oecetis</i>	2		
<i>Polycentropus</i>		1	
<i>Pycnopsyche</i>			1
<i>Setodes</i>	2		
<i>Triaenodes</i>			1
TUBIFICIDA			

Apr 11, 2023 Niangua River - bl. Moon Valley Rd @ Moon Valley Access [1170_7.4]			
<i>Branchiura sowerbyi</i>		1	
Tubificinae		2	
VENEROIDA			
<i>Corbicula</i>	1		

Appendix B

Wadeable/Perennial Stream Biological Reference Criteria for the Ozark/Osage EDU

Fall BIOREF Stream Metric Values for the Ozark/Osage EDU					
Stream	DateTime	TR	EPTT	BI	SI
Cedar Creek - bl. Hwy Z	9/20/2011 9:15	77	11	7.2	3.15
Cedar Creek - bl. Hwy Z	9/27/2001 12:15	85	16	6.9	3.23
Deer Creek - 0.1 mi. ab. Hwy V	9/24/1996 14:00	105	24	5.5	3.72
Deer Creek - 0.7 mi. bl. Hwy V	9/24/1996 12:00	97	27	5.5	3.51
Deer Creek - ab. Oak Hunter Hollow	9/25/2002 18:00	106	25	5.7	3.99
Deer Creek - ab. Oak Hunter Hollow	10/3/2000 10:30	84	20	5.4	3.29
Horse Creek - 0.1 mi. ab. Hwy CC	9/27/1995 10:30	79	14	6.6	3.13
Horse Creek - 0.2 mi. ab. CR 425	9/27/1995 14:30	86	17	6.7	3.4
Horse Creek - CR 425	10/2/2006 10:45	52	4	8.2	2.89
Horse Creek - Hwy CC Bridge	9/26/2000 11:00	56	11	6.9	2.9
Little Maries River - CR 211	9/15/2011 12:55	95	28	5.7	3.61
Little Maries River - CR 211	9/27/2000 10:30	95	21	6.5	3.22
Little Niangua River - 0.1 mi. ab. CR 96	9/14/1995 13:00	84	25	5.6	3.58
Little Niangua River - 0.1 mi. ab. Hwy 54	9/15/1995 10:30	87	22	5.7	3.46
Little Niangua River - 0.1 mi. bl. CR 96	9/17/1996 14:30	86	24	5.3	3.51
Little Niangua River - 0.1 mi. bl. CR 96	9/14/1995 10:30	92	24	5.6	3.61
Little Niangua River - 0.1 mi. bl. CR 96	9/23/1998 14:30	89	28	4.8	3.57
Little Niangua River - bl. Pippin Branch	9/17/1996 10:45	89	24	5.6	3.71
Little Niangua River - Muleshoe CA	9/17/2013 13:45	91	25	5.8	3.41
Little Niangua River - Muleshoe CA	10/3/2000 14:00	68	17	5.9	3.25
Pomme De Terre River - ab. 244th Rd.	9/20/2011 16:00	96	28	5.6	3.23
Pomme De Terre River - ab. 244th Rd.	9/27/2000 16:00	89	25	6.3	3.06
Saline Creek - 0.1 mi. bl. Saline Rd.	9/13/1999 9:00	99	27	6.7	3.37
Saline Creek - Saline Rd.	10/2/2000 11:55	84	20	6.4	3.38
Tavern Creek - 0.1 mi. ab. Hwy 17	9/21/1999 9:30	87	24	6.2	3.46
Tavern Creek - 0.3 mi. bl. Hwy 17	9/15/2011 10:07	104	24	6.5	3.33
West Piney Creek - 5 mi. SW of Houston, MO	9/26/2000 18:00	84	22	6.7	2.79
West Piney Creek - 5 mi. SW of Houston, MO	9/29/1999 11:00	100	30	5.5	3.69

Spring BIOREF Stream Metric Values for the Ozark/Osage EDU					
Stream	DateTime	TR	EPTT	BI	SI
Cedar Creek - 0.9 mi. bl. Hwy Z	4/10/2012 12:00	90	15	6.1	3.47
Cedar Creek - Hwy Z	3/20/2001 10:40	76	20	7.1	3.1
Deer Creek - 0.1 mi. ab. Hwy V	4/18/1996 15:00	89	26	6.1	3.1
Deer Creek - 0.7 mi. bl. Hwy V	4/18/1996 11:30	108	32	6	3.4
Deer Creek - ab. Oak Hunter Hollow	3/22/2000 12:20	111	32	6.1	3.43
Deer Creek - ab. Oak Hunter Hollow	3/22/2000 12:21	110	27	6.1	3.44
Deer Creek - ab. Oak Hunter Hollow	3/31/2003 11:00	113	31	5.5	3.89
Horse Creek - 0.1 mi. ab. Hwy CC	3/22/1995 12:30	79	18	5.6	3.34
Horse Creek - 0.1 mi. ab. Hwy CC	3/27/2000 10:55	78	17	6.4	3.3
Horse Creek - 0.2 mi. ab. CR 425	3/22/1995 16:30	64	17	6.2	3.44
Horse Creek - CR 425	3/19/2007 10:30	85	8	6.7	3.09
Little Maries River - CR 211	3/20/2000 10:00	98	29	6.3	3.42
Little Maries River - CR 211	3/27/2001 10:45	103	26	6.1	3.49
Little Maries River - CR 211	3/27/2001 10:45	110	31	6.2	3.5
Little Maries River - CR 211	3/29/2012 14:00	106	33	5.8	3.6
Little Niangua River - 0.1 mi. ab. CR 96	3/28/1995 16:00	114	39	5.3	3.69
Little Niangua River - 0.1 mi. ab. CR 96	4/16/1996 17:00	94	33	5.7	3.09
Little Niangua River - 0.1 mi. ab. Hwy 54	3/29/1995 9:30	94	34	5.3	3.38
Little Niangua River - 0.1 mi. bl. CR 96	3/28/1995 12:50	98	34	5.1	3.56
Little Niangua River - 0.1 mi. bl. CR 96	4/16/1996 12:30	106	36	5.3	3.54
Little Niangua River - 0.1 mi. bl. CR 96	3/26/1998 11:00	119	31	5.8	3.98
Little Niangua River - 0.1 mi. bl. CR 96	3/21/2000 18:00	91	30	5.7	3.38
Little Niangua River - Muleshoe CA	3/20/2014 10:00	99	31	5.7	3.61
Pomme De Terre River - ab. 244th Rd.	3/14/2000 16:05	105	31	6	2.9
Pomme De Terre River - ab. US 65	4/9/1996 15:30	86	21	6.2	3.04
Pomme de Terre River - 0.3 mi. ab. 244th Rd.	4/9/1996 11:00	96	28	6.3	3.43
Pomme de Terre River - 0.3 mi. ab. 244th Rd.	3/19/2012 16:15	104	32	5.2	3.52
Saline Creek - 0.1 mi. bl. Saline Rd.	3/26/1999 11:00	90	30	6.2	2.85
Saline Creek - 0.1 mi. bl. Saline Rd.	3/20/2000 14:00	93	27	6.4	2.95
Saline Creek - Saline Rd.	4/23/2008 9:00	79	20	5.5	3.17
Tavern Creek - 0.1 mi. ab. Hwy 17	3/15/1999 13:00	87	27	6.1	3.26
Tavern Creek - 0.1 mi. ab. Hwy 17	3/29/2012 11:15	90	28	4.5	3.14
Tavern Creek - 0.1 mi. ab. Hwy 17	4/15/2013 10:05	88	18	5.5	3.56
Tavern Creek - 0.1 mi. bl. Hwy 17	3/27/2001 14:40	97	21	5.9	3.37
Tavern Creek - 0.3 mi. bl. Hwy 17	4/15/2013 10:05	98	22	5.2	3.68
West Piney Creek - 1 mi. W of Clara	4/10/1996 14:00	112	39	5.7	3.45
West Piney Creek - 1 mi. W of Clara	4/10/1996 14:00	104	38	5.2	3.4
West Piney Creek - 1 mi. W of Clara	3/7/2000 11:00	127	42	5.9	3.45
West Piney Creek - 5 mi. SW of Houston, MO	3/22/1999 10:00	110	37	5.6	3.48
West Piney Creek - Hightown Rd.	4/10/1996 9:30	106	41	5.5	3.29